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Molding Connecting Rod Brasses.

BY C. VICKERS.

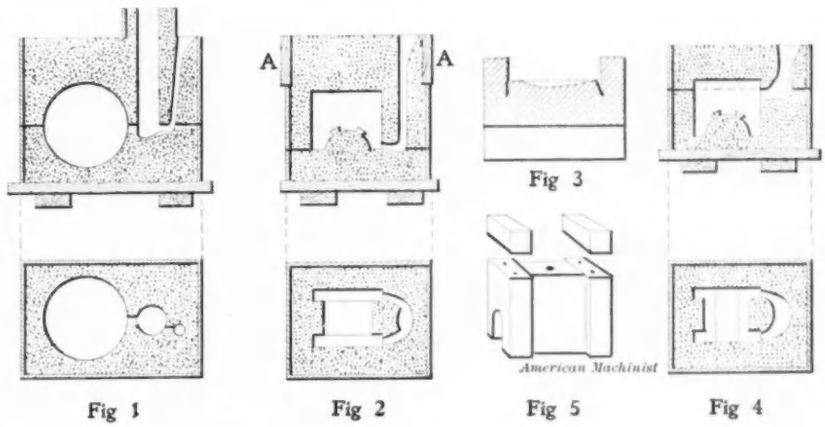
One of the greatest troubles of the molder is the impurities in the metal. Many and ingenious precautions are taken, yet, in spite of all, dirt evades him and shows up in the casting, just particularly where it is not wanted. Much of this dirt cannot be separated by skim gates and such contrivances. Being lighter than the metal, however, it has a tendency to rise to the surface, and when any portion of a casting has to be exceptionally clean it is usual to get that part at the lowest point in the mold. With iron, as far as my observation goes, it is more difficult to obtain a perfectly clean casting than with bronze, as the metal usually contains more impurities.

Speaking of iron reminds me of a method of casting governor balls described to me by the superintendent of a large Western iron and brass foundry. He got his idea from the brass foundry, when they ran such of their work, as was possible by the method described in these columns, under the heading, "Making a Large Brass Casting." Fig. 1 shows the method which I was informed gave much better results than to put the riser on top of the ball, as is usually the case. It will be noticed that the sprue was gated to the shrinker at a tangent to the lower curved surface, thus making it a whirl gate, so as to "ball' the dirt and keep it in the shrinker.

Bearing brasses are always cast bearing down, often making (owing to the manner in which the patterns are usually made) quite a difficult job of a simple one. Fig. 2 shows the method most generally used. The molding is commenced by placing the pattern bearing down on the follow board or match. The cope is placed over and the sand is rammed in. Upsets or deepeners, preferably of wood, *A A*, are used to increase the hight of the cope to at least 6 inches above the highest part of the pattern to insure the casting running up full. The cope is then inverted ,the parting is made, and the nowel placed on, rammed and vented, after which the mold is again rolled over and the cope lifted off carrying the pattern. Thus the mold must be rolled twice, for even if the nowel is lifted, carrying the bearing core, the mold must be rolled when finished. Before the pattern is drawn, the sand around it must be spiked to prevent the corners dropping off when closing.

A great deal of ramming may be dispensed with, if, instead of carrying the mold up to the full hight of the sprue, it is made no higher than dictated by safety, and the sprue carried up by means of a bushing. In this case the pouring must be done with a shank, as the bushing would be displaced if the lip of the pot rested on it, as is usual with the side tongs. To insure a sound casting the metal must be hot, and the sand over the top of the casting must not be rammed too solid. If the metal is too cool, the casting will probably present the appearance shown in Fig. 3, which is a longitudinal section through the center of the bearing. It will be noticed that the back is hollow or "shrunk," and that there are shrinkage cracks at the juncture of the flanges with the body of the casting. In the case of hot metal and a hard rammed mold there will be the same "shrinkage" or hollow on the back; it will, however, generally present a little different appearance, and instead of being smooth, will be rough or scaly, and will suggest that after the casting was set, a portion of the metal, rich in tin, had oozed out and spread itself over the hollow part. The same thing may often be observed with heavy sprues and risers of hard bronze. After the head has shrunk down and a skin has formed, metal will be seen to ooze from beneath and flow over the top, forming a button, which, when cold, is of a whitish color, and may be easily broken with a hammer, showing it to be rich in tin. It is only when the metal has been used hot that I have noticed this segregation of the tin. In the case we are supposing, of a hard rammed mold, etc., the gases being unable to escape freely, are compressed by the advancing metal and form a hollow. By the time the air has escaped the metal has begun to congeal, and a skin has formed on the outside of the casting. This skin is thinner at the hollow on account of the heat not being absorbed so quickly by the air as by the damp sand; the thin skin is not strong enough to withstand the internal strain, and it "bleeds." Sometimes this bleeding will entirely fill the hollow; in such a case that part of the casting will present a white "tinny" appearance, sometimes porous and sometimes not. The vent wire will sometimes antidote hard ramming, but not always. Often the back will be lumpy, "run up" where the vents happened to be and hollow between. I have expanded on this subject considerably, because I have seen much loss from this cause.

All this trouble may be avoided by the method of molding shown at Fig. 4. Here the casting is gated higher up,



MOLDING CONNECTING ROD BRASSES.

preferably on the flange on a level with the top of the box, and the sprue is of such a size as to be able to feed the casting; consequently lower copes can be used, cooler metal may be poured, and cleaner casting secured—labor saved all around. To secure these blessings the mold must be made in three parts. Fig. 5 shows how the pattern should be. The flanges above the body are loose and pinned. The pattern is given draught, so that it can be drawn by inserting the drawspike in the back, instead of in the bearing. In molding the loose flanges are removed, and the pattern is placed bearing up on a smooth board (neither follow board or match is necessary). The nowel is placed over, rammed, vented and rolled, the parting brushed off, loose flanges adjusted, gate patterns placed in position, and the cope rammed and removed, carrying with it the loose pieces. These and the pattern are drawn and the mold is finished—quite an easy job. When the flanges, instead of being straight, project at the sides to lengthen the bearing, such pieces can be loose, cast in aluminum so they will not break, and pinned so that, after the pattern is removed, they can be withdrawn sideways. This alteration of patterns will save in the labor of molding no less than 25 per cent., and reduce the chances of bad castings to zero. The above remarks on shrinkage apply more particularly to heavy rod brasses; light ones give no trouble on this account; they are more easily molded, however, if the patterns are made as suggested.

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Refractory Furnace Surfaces.

BY W. H. BOOTH.

It is a curious thing that true principles require so long to become recognized. In nothing is this more marked than in the combustion of fuels, especially of that class of fuel which is not consumed upon the grate. Coke and anthracite are completely oxidized upon the grate; they make no flame, unless it be the short flame of carbon monoxide burning on the surface of the fuel bed. But bituminous coals give out large volumes of hydrocarbon gases which burn with a long flame that may extend 60 or 80 feet, and it is in the economical combustion of these coals that difficulties arise, especially in regard to smokiness. One cause of smokiness is that in the attempt to burn hydrocarbon gases the hydrogen burns the more easily and seizes the particles of oxygen, leaving the carbon unconsumed. But even with an ample supply of oxygen there may still be smoke, and before we can think of attempting to stop smoke we must understand the reason of its formation and the principles which govern combustion.

There is one grand principle: No substance will ignite unless first raised to a certain temperature, and it will not burn freely unless allowed to get hotter than the minimum temperature of ignition. Applied to coal and coal gas we may set down the minimum temperature of ignition at, say, 800° Fahr., and the minimum temperature for continued combustion as 1,000° Fahr. A full furnace temperature may well be 2,500° Fahr., and this is ample to throw off large volumes of gas from freshly charged fuel and to set it burning freely. But if we allow these freshly ignited gases to flow among a nest of cold water tubes the gas will be so cooled that its further combustion will be either stopped or rendered very imperfect. An example well known in the laboratory of cooling a flame to the point of extinguishment is the placing of a coil of platinum wire round a candle flame, which may thereby be cooled out altogether.

In spite of the many thousands of practical examples the progress of furnace work has been slow, and it is only comparatively recently that I have observed attention given to the principle of refractory lining. Now, a good many years ago I saw in operation in Manchester a boiler of multitubular type to which was fitted a furnace which was simply a rectangular box of firebrick. There was no means of cooling this box, and combustion completed itself so that no smoke was made. The gases were maintained hot until combustion was complete. Let us compare this with ordinary practice. Take, first, the externally fired boiler. As once set the boiler came down very close to the grate, but it was found that better results were obtained by raising it to about 2 feet from the grate. The sides of the furnace are simply walls of firebrick, which do not abstract heat from the fuel; the only cooling element is the boiler above, and where the coking system of firing is practiced wholly or in part experience has demonstrated the necessity of building an arch of brick over the place where the fresh fuel is heaped in, so as to heat and ignite the new gases. Experiments have shown in internally fired boilers that a thin stratum of cold gas travels along the furnace crown and carries with it much energy unutilized. The internally fired boiler, so much used in England, is faulty in the point of combustion, because the whole furnace is contained in a cooled tube of plate not above 300 to 350 degrees of temperature. Then in the portion of the tube beyond the furnace there are generally placed water pipes across the tubes, and these entirely check further combustion. In water tube boilers the freshly generated gases are hurried unburned between masses of cold water tubes, which effectually stop further combustion. In boilers of the locomotive type the whole fire-box is cold and smoke is rolled out in immense volumes; but if we build a brick arch across the fire-box, so as to prevent the direct passage of the green gases to the tubes, and instead compel them to travel round an incandescent mass of brick work, and if we assist the ingress of air by a blower, we may secure perfect combustion in this type of boiler. It is thus becoming slowly acknowledged that burning gases must not be too quickly cooled. They must be allowed to complete their combustion before heat is abstracted from them.

A study of boiler design generally reveals the fact that the aim of the designer has been to rob the burning fuel of its heat as soon as ever he could, and in this he has been totally wrong. An entirely lined furnace may not be necessary, and beyond what is necessary we need not go. Thus in the locomotive the brick arch in the midst of the furnace is found enough to stop smoke. But the brick arch thus placed has a duty beyond that of preventing too rapid cooling off. Its duty is to compel all the gaseous products of the furnace to travel by a certain point, where any necessary fresh air can be administered, and the arch delays the time of passing to the tubes, and thus allows time for combustion, and puts a stop, moreover, to the direct streaming to the tubes of gas direct from the fuel on the grate. Without the arch there is no intermingling of gas and air, which is necessary to combustion; the arch does this, as well as serving as a heat store, and to divide the fire-box to give a convenient combustion chamber. All boilers with bridge walls have this mingling arrangement, and are good on this point. If, then, a boiler is found to be smoky, an endeavor should be made to add to the ratio of the refractory surface in the furnace, in order that temperature may be conserved.

For internally fired boilers the partial lining with firebrick is not difficult, as the bricks can readily be arched in. Experience alone can decide how much brickwork should be used. It may be placed so as to afford a cellular structure, the plates being exposed at the openings only. It may be placed as a series of narrow rings, each of which will stop the flow along the plates of any continuous stream of quenched gases, and compel them to pass over the regenerating surface. The use of unlined furnaces with blocks of firebrick in the flues beyond the boiler is to my mind wrong. It is an endeavor to remedy, by the giving out of heat taken up from a bright and clear fire, a fault which should not have been made. It is in fact an attempt to return to the gases heat which ought not to have been abstracted from them in the furnace. Therefore the system is faulty. The refractory material should be in the furnace and the gases should be left to remain hot as long as necessary for perfect combustion, instead of being too promptly robbed of heat, only to be re-

heated beyond the bridge, where if kept originally hot they would complete their combustion, and only then be fit to be cooled by wate contact.

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Mechanically Originating a Dividing Wheel.

BY JOHN RANDOL.

It seems correct, in this instance, to place the cart before the horse by saying that I expected to find in the construction steps of the Newton dividing wheel nothing more noteworthy than an interesting new solution of one of the old mechanical riddles, but that a study of this construction has convinced me that it involves a new theory of dividing-wheel production, and that this theory is correct and will produce almost perfectly divided index wheels.

I am also led to the conclusion, which is important if correct, that a really true dividing wheel cannot be produced by transfer, and that only original dividing wheels can be expected to be correct.

This conclusion is to a very great extent verified by the fact that none of our dividing wheel makers will guarantee to produce a dividing wheel without discernible error.

The method here described was devised, I believe, chiefly by Mr. Champion, of the Newton Machine Tool Works, Philadelphia, who recently completed a gear cutter (fully described in the "American Machinist" for October 2, 1897) large enough to cut gears 12 feet in diameter, and the steps taken to furnish this large tool with a good dividing wheel form a very interesting chapter in the history of dividing engines. If the wheel to be cut is of a larger diameter than the dividing wheel, then the original errors of the dividing wheel are magnified in the work spaced by it. Hence the dividing wheels of gear cutters are always made as large as convenience will permit, but there are many practical considerations which limit this diameter.

The largest work to be done by this Newton gear cutter is nearly four times the diameter of the dividing wheel, any errors in the dividing wheel being thus multiplied nearly four to one in the largest work the machine can make.

In the case of an old gear cutter of long established reputation, the usual excuse of "expansion through local heating inseparable from the action of large milling cutters" might serve, as it generally does, to divert suspicion from the really faulty dividing wheel.

The Newton dividing wheel blank, in the first instance made solid, with no expectation of any correction subsequent to the original cutting being needed, was duly cut by transfer from the dividing wheel of a gear cutter of standard make, and was to all appearance a fine piece of work. Careful inspection, however, cast doubts upon its accuracy, and two plates of the same diameter simultaneously divided with a fixed straight-edge and carefully scribed lines showed, when the plates were turned round on each other, an error of such magnitude as to make the use of the wheel inadmissible. This solid dividing wheel was then taken to the hobbing machine, Fig. 2, one of the Newton shop machines, in which the wheel to be hobbed and the hob itself are both geared to their correct relative speeds. This machine should, theoretically, hob a solid worm wheel with accuracy, but in practice it does not do this. Errors creep in, probably from slight differences in density of the metal, and stay in, no matter how sharp the hob teeth are, or how carefully the hobbing is manipulated. This hobbing machine will cut solid worm wheels, which work well as spindle drivers, for which purpose they are largely employed in the Newton practice, but it may be safely said that no solid worm gear is made without errors easily detected.

Consequently this single piece dividing wheel was laid away in a safe place, and lies there yet, and a split wheel was made of the section shown in Fig. 1, the intention being to turn the loose part of the rim on the other part and correct the teeth mechanically until they matched perfectly in any position, the hobbing machine being expected to effect this correction without resort to hand labor of any kind.

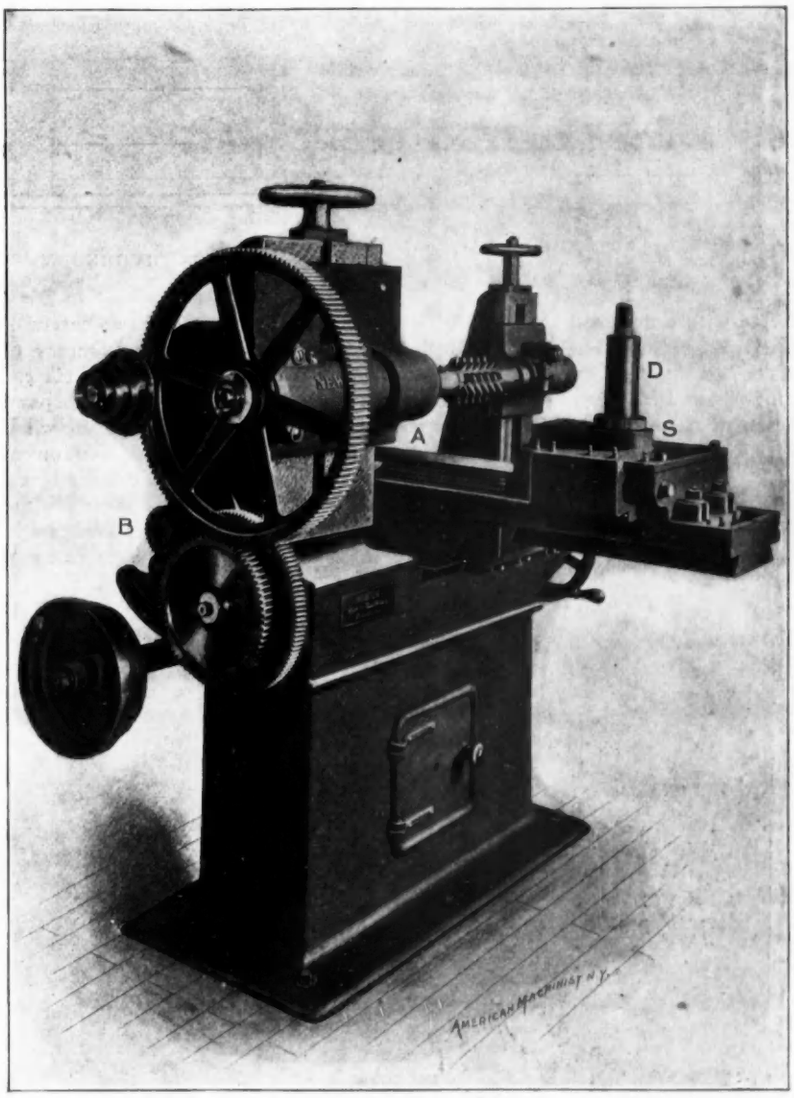

FIG. 2.—NEWTON HOBBING MACHINE.

A large dividing wheel in a well-known tool shop, which is very nearly without error, and is considered one of the most accurate dividing wheels in existence, has its rim in two parts, and, if memory serves correctly, two expert fitters were employed for about six months in scraping the teeth of the two parts so that they would accurately coincide in all positions.

To prepare the Newton blank for toothing, four one-half inch fillister

screws, having three-quarter inch heads, were used to hold the two parts together, these screws being placed in a fine line circle made in the lathe, and quartered as nearly as possible by careful scribing on the gear cutter, though, as it proved, not with a very close approach to accuracy. These holding screws are not shown in the drawing. Then four center marks for taper pin seats were located in the same circle by very careful use of the tram. The taper pin holes were first started with a fine drill to about half an inch in depth, and next the full size drill was passed entirely through, the taper pins being about three-eighths of an inch at the small end. Next all four of the pin holes were reamed with a carefully stoned taper reamer, the reamer cut being carried nearly through the rim. Then the fillister heads of the half-inch holding screws were reduced in the lathe, and the body holes for these screws in the top part of the wheel rim were enlarged with a file. Following this the wheel rim parts were turned half way round on each other, and one taper pin was put in place. This, of course, made the discrepancy in coincidence of the taper hole opposite the pin double the actual variation from accurate diametric location. The interior of this hole was examined with a glass, and the difference was divided as accurately as possible; the wheel rim parts were clamped together with the fillister holding screws, and then all the taper holes were reamed again, the taper reamer being turned down to exactly the same depth in each hole. This operation was repeated until the four reamed holes would stand anywhere with each other without perceptible variation, the reaming occupying two careful hands nearly four days. The accuracy of the finished dividing wheel depends entirely on the accuracy of the correspondence of these taper pin holes in the wheel-rim parts, and it is this conception of accurately locating the pin holes by the use a tapered reamer which gives this method of originating dividing wheels its cheapness and its certainty of accurate results.*

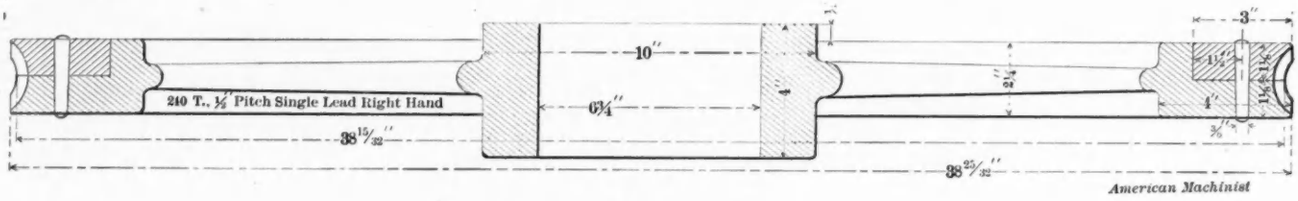

FIG. 1.—NEWTON DIVIDING WHEEL.

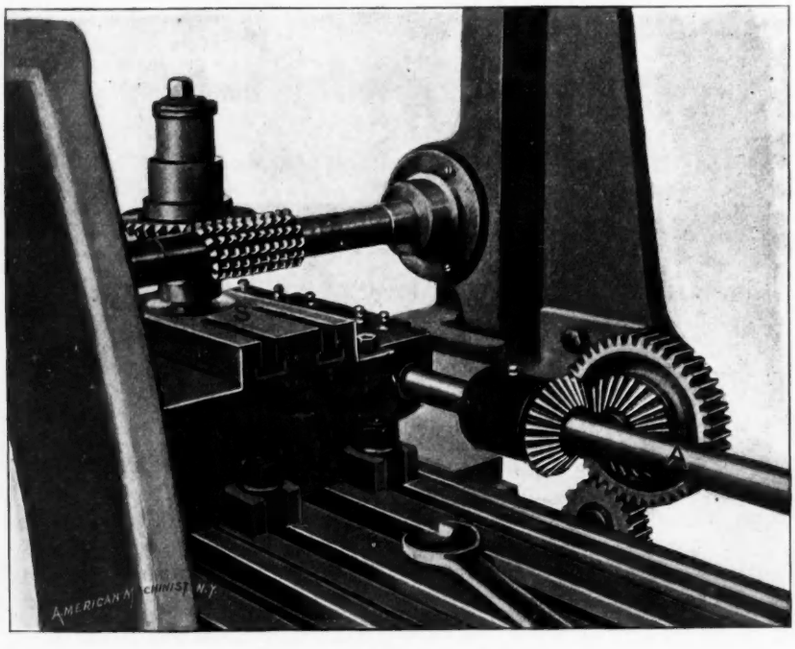

FIG. 3.—PART OF HOBBING MACHINE.

When the taper pin holes were satisfactorily located, the wheel was taken to the hobbing machine, Fig. 2, and hobbed from the solid, without preliminary "gashing" in the gear cutter. The hobbing was carried pretty well down to finished size, and then the wheel-rim parts were turned half way round on each other. The teeth were found to show about 1-64 inch discrepancy. Hobbing was continued until the teeth looked alike, and upon again testing by turning the rim parts on each other the spacing was found to be almost perfect. Very light hobbing was continued, the wheel being moved twice more, a quarter turn each time, the discrepancy of tooth position being divided as long as perceptible, which made one complete revolution of the wheel parts on each other. Then the wheel was hobbed around four times more, being moved a quarter turn each time, with the hob barely cutting, which made in all eight different rim-part position hobbings, the time occupied on the hobbing machine being about two days.

When the dividing wheel left the hobbing machine no discrepancy in the matching up of the teeth could be detected in any one of the four positions, either by touch or with the magnifying glass, and a test made by simultaneously cutting two six pitch gears about 30 inches diameter spaced by the new dividing wheel showed that the gears cut would turn round on each other in any position without showing any discrepancy in tooth position which could be perceived either by touch or glass.

In considering this apparently successful attempt to mechanically correct faulty index wheel spacing it becomes evident that the success of such mechanical correction must be due to the imperfections of the hobbing machine, Fig. 2, in which this mechanical correction was performed, and we have not far to look for a solution of this paradox. Fig. 3 is a detail view of the wheel-moving devices which turn the blank in process of hobbing in the hobbing machine. *B*, Fig. 2, is the change gear which gives the correlative speeds of the hob and the gear blank. This motion is transferred through miter gears, Fig. 3, to the worm shaft *A*, Figs. 2 and 3, and is transferred to the gear stud *D* by a worm gear concealed in the saddle *S*.

Now, it is not conceivable that all of the gears which in this hobbing machine drive the hob and the gear blank are ab-

* This process will be found fully described by Mr. Baxter in an article on the making of jigs for drilling the end rings of armatures, published in our issue of September 16 last, and in the issue of September 30 will be found a suggestion by Mr. Griffin that the process offered a means of making correct index plates.—ED.

solutely perfect in spacing, nor is it to be supposed that the hob and gear blank spindle are without such slack in their connections as to render their actual relative angular positions at any instant a matter of entire uncertainty, within certain small limits of variation, and this is the condition of hobbing machine imperfection which is essential to the mechanical correction of a dividing wheel by the Newton method.

If the hobbing machine were without lost motion between any of its transmitting parts, then, clearly, some of its own errors in tooth spacing would be transferred to the blank in process of hobbing, and make correction impossible. But there is a certain small slack between the transmission elements, and if this slack is enough to permit the dividing wheel blank to have a free angular movement with regard to the hob teeth greater than the effective aggregate of all the errors of the hobbing machine gears and the errors in the dividing gear blank under correction, then, by carefully dividing the discrepancies in tooth correspondence in the two halves of the dividing gear rim, the hob and gear blank can and will mutually adjust themselves so as to correct the faults of the gear blank.

By having the two parts of the wheel accurately quartered by the taper pins the imperfections of the hobbing machine permit, or rather insure, an almost perfect mechanical correction of the divisions when manipulated in the manner detailed. The errors of this orignal dividing gear are unknown. It undoubtedly has errors, but they are so small as to be undiscoverable by any shop tests.

The immediate result of the advent of this accurate dividing wheel in the Newton shops was the overhauling and recutting of all the shop index plates and their great improvement.

It does not seem probable that any transfer can be made from a dividing wheel which will equal the original in accuracy. Those not practically acquainted with the action of cutting edges on metal may believe it to be uniform, but all men familiar with the making of "duplicate" cuts in the shop well know their difficulties, and it really seems as if the only sure way to obtain an accurate dividing wheel, or one so nearly approaching absolute accuracy as to be without faults in practical use, is by origination of some kind, and origination by the method here described seems the cheapest and most certain of any yet proposed.

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It is announced that what may be considered the greatest stronghold of cable traction is soon to surrender. The Broadway line in this city is to adopt the underground trolley as soon as the necessary consents of property holders are secured.

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As indicating the progress in the development of autocars abroad we note that two companies have recently been organized in France for their manufacture, one called the Société des Automobiles et Moteurs Henriod, of Neuilly, and the other the Société des Voiturettes Automobiles Schmidt, of Paris, and it is stated that thirty firms have applied for space in the June exposition of the Automobile Club, Paris.

Practical Application of High Range Compressed Air Power Transmission.

BY FRANK RICHARDS.

I use the term high range to designate the system here referred to for convenience, as it seems to fit the case, whether it has been used before or not. The system is called also the two-pipe system, on account of the return pipe made necessary to convey the air which has done its work back to the compressor, the exhaust pressure being constantly maintained very much higher than that of the atmosphere. The system has been put into practical operation in California and elsewhere in the far western portion of the United States, being known there as the Cummings sytem of compressed air transmission, the apparatus there employed being under United States patents granted to Charles Cummings, of Oakland, Cal.

Under this system the compressor in full operation receives the air returning from rock-drills, pumps, hoists, motors, or whatever it is employed to drive, at a pressure considerably above that of the atmosphere, compresses it to a still higher pressure, and then sends it out again to do more work. The operation as thus stated is as simple as that of the ordinary air compressor, which takes in free air, or air at atmospheric pressure, and sends it out again at a pressure of, say, 6 or 7 atmospheres. In compressing from 1 to 7 atmospheres or in compressing from 7 to 14 atmospheres there is no essential difference in the operation involved.

If the compressor is to work at any-

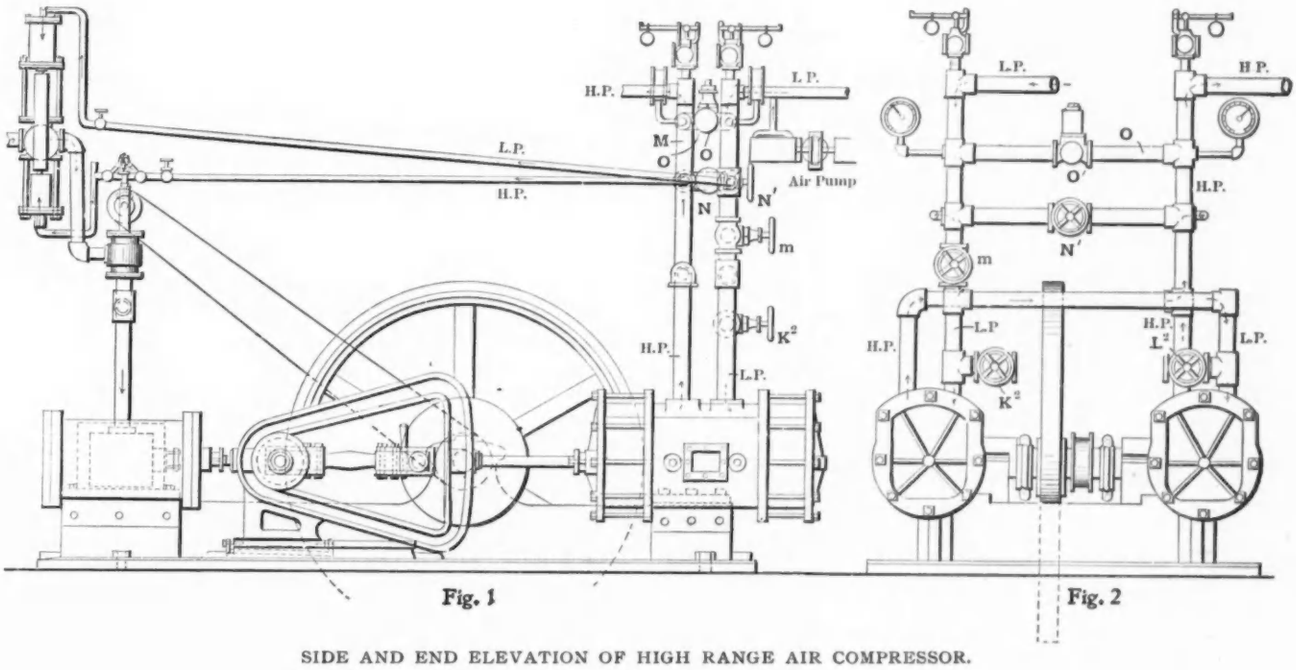


Fig. 1 Fig. 2

SIDE AND END ELEVATION OF HIGH RANGE AIR COMPRESSOR.

thing like the pressures last indicated there must, however, be some provision for first charging the system to the high initial pressure required, and also some means of governing or controlling the speed and output of the compressor according to the rate at which the air may

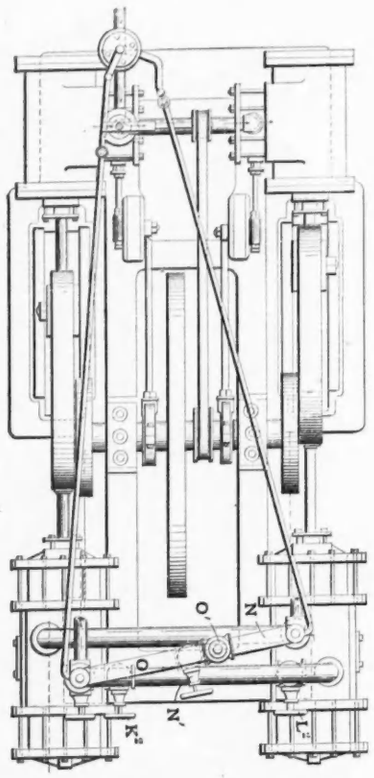


FIG. 3.—PLAN OF HIGH RANGE AIR COMPRESSOR.

be used at the other end of the system. The arrangements by which these results are accomplished are worth looking into. Fig. 1 is a side elevation, Fig. 2 is an end elevation and Fig. 3 a plan of a duplex steam driven compressor. Of the general design of the compressor it is not necessary to speak. It will scarcely be maintained that it represents the best possible arrangement. The steam cylinders are at the left, Fig. 1, and the pull and thrust of the steam piston is transmitted directly through the yoke in which the connecting rod plays to the air cylinder. The body of the air cylinder is water jacketed and the valve chambers on each end have each a vertical partition, the inlet valves and pipes being on one side and the discharge valves and pipes on the other. The air being at normal atmospheric pressure throughout the apparatus we may start the compressor, referring principally to Fig. 2, and as we proceed the functions of the pipes and connections will reveal themselves. Both compressing cylinders are alike in construction and operation. At the beginning of operations we may assume the globe valve M to be closed and all other valves to be open. The free air will enter through valves K^2 and L^2 and the compression will continue until the pressure rises to, say, 100 pounds, if we assume that pressure for the lower limit of our working range. When the pressure of 100 pounds is reached valve N^1 is closed by hand, separating the high pressure and the low pressure pipes, and the operation of compression then continues until the high pressure pipes are filled to the high pressure required, say 200 pounds, while the low pressure system remains charged at 100 pounds. The air inlet valves K^2 and L^2 are closed by hand and valve M is opened, allowing the 100 pound air to be delivered to both cylinders. The entire apparatus is now a closed system, with both the high and the low pressures as required, and ready for continuous action. A small pump U, shown in Fig. 1 up at the right, replaces what air may be lost by leakage. This pump may be placed wherever most convenient and may be operated by connection with the main compressor or otherwise, and here requires no further mention.

Attention is now called to cross pipe O. This pipe directly connects the high pressure and the low pressure pipes. Somewhere between the two pipes is located the valve O'. This is an adjustable pressure valve which may be set to open at any predetermined difference of pressure, in this case 100 pounds, and it will not open until that difference exists, when any excess of air in the high pressure pipes is automatically discharged into the low pressure, thus constantly maintaining the required difference. The compressor may be charged or put in condition for continuous operation by the use of this automatic valve instead of by the hand operated valve N^1.

The operation of governing an air compressor, either under the system we are considering or any other, is distinctly different from that of governing a stationary steam engine. The amount of power required may fluctuate in either case, but in that of the steam engine it is still usually necessary to maintain a constant rate of speed. In the case of the air compressor it is necessary to vary the speed according to the work. With our closed circuit of piping, and assuming the compressor at one end and the motor at the other, each running at such relative speeds that the difference of 100 pounds is just maintained between the two pipes, if it should then happen that the motor should be run slower, or in any way should require less air to pass through it, then if the compressor still maintained its speed the pressure in the high pressure pipes would become too great, while in the low pressure pipes the pressure would fall too low. The reverse operation would result as badly in the opposite direction. A centrifugal governor is provided, as shown, to control the speed of the compressor when the demand upon it is up to its full capacity and prevent it from running away. This governor may also come into play in the earlier stages of the initial charging of the system, but is of no use at other times, the differential pressure governor being the usually operative controlling device. This governor, which it is scarcely necessary to describe in detail, is indicated in outline up at the left of Fig. 1. It consists of two cylinders of different areas, say one twice that of the other,

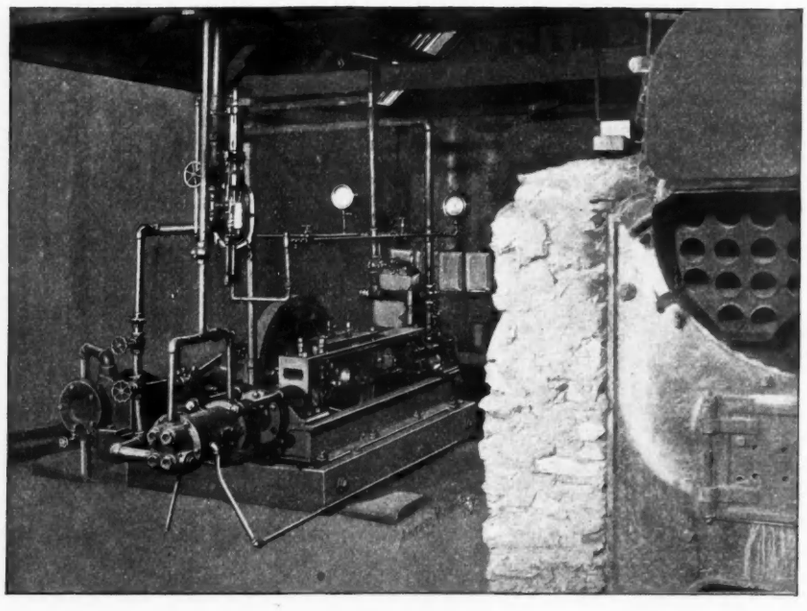


FIG. 4.—HIGH RANGE AIR COMPRESSER IN SERVICE.

the two pistons being connected and moving together and by their movement operating a sliding steam valve and controlling the flow of steam to the steam cylinder. These governor cylinders standing vertical, and that of the larger area being above, with the smaller cylinder below, a small pipe connecting with the low pressure system is led into the top of the large cylinder, while a pipe from the high pressure system enters the bottom of the lower and smaller cylinder. The differences in pressures being compensated by the differences of piston areas, the piston and the steam valve are stationary when the difference in pressures is normal, while if the high pressure increases the steam valve closes and slows the compressor, and if the high pressure falls while the low pressure increases then the steam valve moves in the other direction, more steam is admitted and the compressor runs faster. The compressor being duplex, with cranks at right angles, it will of course start itself from any position. The compressor for this system, it will thus be seen, requires little complication above that of the ordinary compressor.

It is proper to say a little as to the actual practical workings of the system. As is well known, the use of compressed air is perhaps better developed and better appreciated upon the Pacific Coast than anywhere else in the United States. Some admirable installations of the ordinary type are in operation there and some notable instances of large plants and long distance transmission. It is not strange that the two-pipe system also should find its first employment in the same section. It can scarcely be claimed for it that its possibilities have yet been all developed or that its applications have been other than crude and cheap. The half-tone herewith speaks for itself as to the conditions under which it has been tried (or it would have so spoken if the engraver had not taken such pains to make the scene respectable). The compressor here shown is of different construction from that which I have described, but it embodies the same two-pipe principle. As to the results attained, there are not as yet any thorough, careful and precise tests to be referred to, and we must be content with statements such as the following:

"Two tests were made of three hours each, one with the machinery run under the two-pipe system, and the other with the same machinery run under the ordinary system. In each one the same machinery was used throughout. This consisted of a duplex air compressor with air cylinder 5x9 inches, and steam cylinder 6½x9 inches, and a water pump with air cylinder 4½x7 inches, and water cylinder 5x7 inches." These dimensions are not altogether clear and satisfactory, but I give them as I have received them. The statement of comparative performance which follows is more intelligible.

"The machinery was run for three hours under the two-pipe, high range system. One of the pipes was then disconnected and the same machinery was run under the ordinary system. That is to say, instead of exhausting into the return pipe, the exhausting was done into the atmosphere. The pump was employed in elevating water 80 feet. The first three hours under the two-pipe system the pump made 23,877 revolutions while the compressor made 16,735 revolutions. In the second three hours, running under the ordinary system, the compressor made 22,735 revolutions and the pump 5,380." There was, of course, no such advantage as the figures given seem to indicate, but that there was a great advantage seems clear. "In the two-pipe system we ran the pump about as fast as is consistent with good practice, while the compressor had to be run comparatively slow. In the ordinary system we could hardly run the compressor fast enough to give sufficient air to the pump to turn over. We had great difficulty in running three hours under the ordinary system, owing to the fact that the temperature in the exhaust ports of the pump came below the freezing point of water. We had to use petroleum to make the pump work. Of course, under the two-pipe system there is no chance of any ice being formed from the expansion of the air."

Hans C. Behr, in a bulletin of the California Mining Bureau, says: "The incidental advantage in the two-pipe system is that the pump engines, particularly if direct acting, can be operated under water until they wear out." He says also: "To properly estimate the value of this system it must be compared to the reheating system as to mechanical efficiency, first cost and simplicity of construction and manipulation." I have seen also enough other letters to probably convince any ordinary person that this system gives quite astonishing results.

▲ ▲ ▲

Arrangement for Cooling Condensing Water.

The two half-tones show quite clearly the means employed for cooling the condensing water at the Jerome Park Reservoir, in this city, as mentioned in our issue of March 31. Fig. 1 shows nearly the entire length of the chute from one pair of the engines and Fig. 2 shows the end where the water finally falls over the cooling platforms. The chute, which is about 4 feet wide, has a flat bottom with a slight, regular incline, and the water flows along in a sheet, say, an inch deep. At the end it drops into the barrel, and overflowing all around it spreads practically all over each platform in succession. The barrel, which is a common oil barrel, gives a good idea of the dimensions, so that no figures need be given. The quantity of steam shown rising is evidence of the rapid cooling going on. The water as it leaves the engines is not too hot to bear the hand in it. The water from the pond is pumped up into a smaller reservoir by a steam pump.

FIG. 1.—COOLING TROUGH FOR CONDENSING WATER.

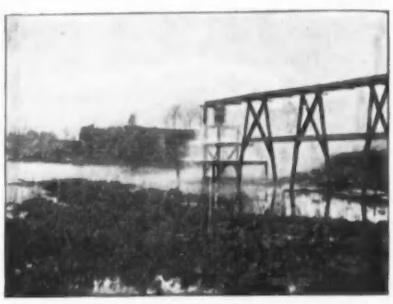


FIG. 2.—COOLING CONDENSING WATER.

▲ ▲ ▲

A Machine Tool of the Last Century.

BY W. S. DURFEE.

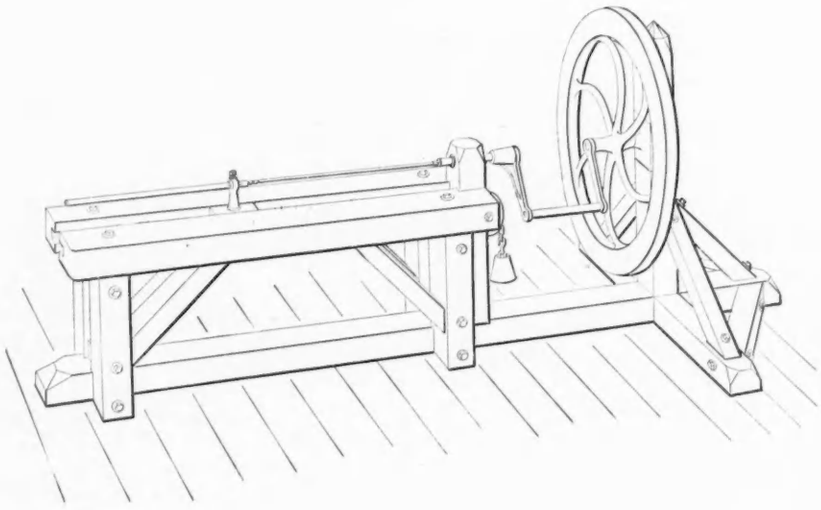
The perfection of ancient handiwork, as illustrated by the examples furnished by the discoveries amid the ruins of the cities, domiciles and tombs of historic races, is a constant surprise to the present generation. So far as known, little mechanism was employed to aid the strength and skill of human muscle. An axiom of the mechanic arts in ancient days was: "If one man cannot accomplish a certain task, more men can." Those were the days that tried men's strength; nothing was known of the soul and less was cared. The development of mechanism was painfully slow, and the first contrivances which could be classed as machine tools were but rough crystallizations of fragments of ideas, of the most clumsy and uncouth forms.

A short time since I found in a work ("An Essay on Shooting," the author's name not given), published in 1791, a description for a mill for boring gun barrels, which afford a good illustration of the kind of machine tools in use in England at that comparatively recent

date. There was no engraving with the text, but I have endeavored to pictorially translate the description by the accompanying cut.

The author's second chapter is devoted to the method of "Boring and Dressing of Barrels" (chapter one being on "Forging of Barrels"). His account has a special interest, as in it is found what is believed to be the first mention of anything like a twist drill for boring metal. The author says: "The next operation consists in giving to the barrel its proper caliber; this is termed boring, and is performed by means of the following machine:

"Two beams of oak, each 6 or 7 feet long and about 6 inches square, are placed horizontally and parallel to each other, by having each of their extremities morticed upon an upright piece, which is of equal strength, about 3 feet high and firmly fixed. Between the horizontal pieces there intervenes a space of 3 or 4 inches, in which a piece of wood



GUN BORING IN THE LAST CENTURY.

is made to slide, by having at either end a tenon that is let into a groove which runs on the inside of each beam its whole length. Through this sliding piece there is driven, or rather screwed, in a perpendicular direction a strong pin or bolt of iron, having at its upper end a round hole or eye large enough to admit the breech end of the barrel, which is secured in it by means of a piece of iron that serves as a wedge, and a vertical screw that passes through the upper part of the eye or hole. To a staple in one side of the sliding piece there is fastened a chain, which runs between the two horizontal beams, and passing over a pulley at one end of the machine has a weight which may be hooked on to it at pleasure. Immediately above this pulley and between the ends of the beams there is fixed an upright piece of timber, whose upper end is perforated by the axis of an iron crank that is furnished with a square socket, the other axis being supported by the wall or by a strong post, and loaded with a heavy wheel of cast iron, to give it force; the axes of this crank are in a line with the eye of the bolt already mentioned. The borer being fixed into the socket of the crank has its other end, which is previously well oiled, introduced into the barrel, whose breech part is made fast in the eye of the bolt; the chain is then carried over the pulley and the weight hooked on; when, the crank being turned by the hand, the barrel advances as the borer cuts its way, until the instrument has passed through its whole length. The boring bit is a rod of iron, somewhat longer than the barrel, one end being made to fit the socket of the crank and the other being furnished with a cylindrical plug of tempered steel, about 1½ inch in length, and having its surface cut in the manner of a perpetual screw, the threads (which are five or six in number) being flat, about ¼ inch in breadth, and running with very little obliquity. The furrows are of the same breadth as the threads and of a sufficient depth to let the metal cut out by the latter pass through them easily, so as to keep the instrument free. This form gives the bit a very strong hold of the metal, and the threads being sharp at the edges scoop out and remove every roughness and inequality from the inside of the barrel and render the cavity smooth and equal throughout. A number of bits, each a little larger than the preceding one, are afterward successively passed through the barrel in the same way, until it has acquired the intended caliber.

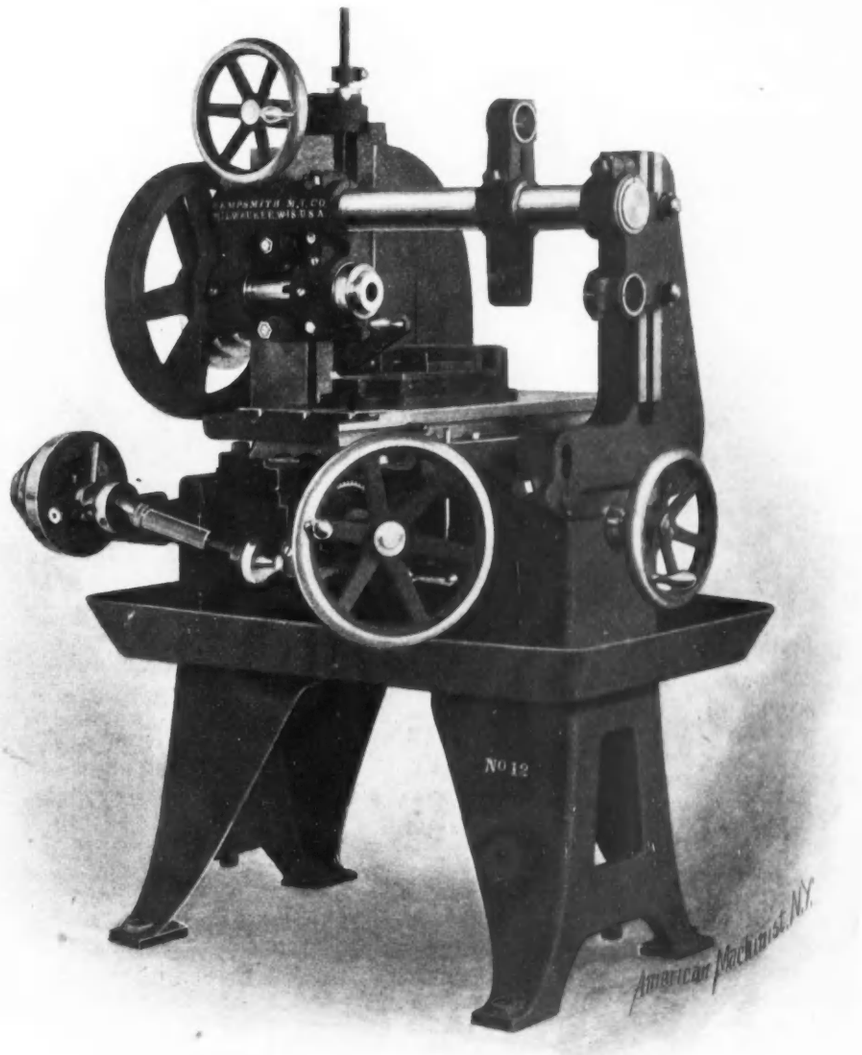
"The borer heats the barrel very much, especially the first time it is passed through, and generally warps it more or less. To prevent this in some measure, the barrel is covered with a cloth, which, by being kept constantly wetted, hinders the barrel from becoming too warm, and also preserves the temper of the boring bit. The borer is likewise withdrawn from time to time, to clear away the shavings of the metal, to oil the bit afresh and to repair any damage it may have sustained during the operation. The barrel is carefully examined every time a fresh bit has been passed through, to see if it be in the least warped by the boring, and also to discover if there are any spots—called by the workmen *blacks*—on its inside. If it be cast or warped it is carried to the anvil, where by a few light strokes of the hammer upon the convex parts it is brought perfectly straight again; this is termed setting up the barrel. If, when the barrel is nearly arrived at the intended caliber, any dark spots are perceived upon its inside by looking through it when held up to the light, the part is marked upon the outside and by striking it gently with the hammer is driven in so as to be completely removed by repassing the boring instrument.

"To ascertain the quality of the bore a cylindrical plug of tempered steel about 1 inch long, highly polished, and fitting the bore exactly, is screwed upon the end of an iron rod and introduced into the cavity of the barrel, where it is moved backward and forward, and the places being marked where it passes with any difficulty, the boring bit is repeatedly passed until the plug moves through every part with equal ease. * * * It now remains to smooth the inside of the barrel and remove the marks left by the boring instrument. This operation is termed fine boring. The instrument with which it is performed resembles in its general form the boring bit already described; the cutting portion of this, however, is a square broach, 10 or 12 inches in length, highly polished and very sharp, whereby it cuts the metal very smoothly. As it is found to cut more smoothly and equally when only two of its edges are allowed to work, the other two are covered with slips of paper, well oiled, being laid along one of its sides, one or more additional slips being put on every time the instrument is passed through the barrel. This instrument is repeatedly passed through the barrel, from breech to muzzle and from muzzle to breech, until the inside presents to the eye a perfectly equal and polished surface; the barrel is also examined at each time, and, if necessary, set up in the manner already described. It is very essential to the perfection of the fine boring that the instrument employed be forged perfectly true, one that has not been cast or warped in the tempering. * * * The barrel is now in a condition to receive its proper form and proportions externally, by means of

the file. To do this with accuracy four flat sides or faces are first formed; then eight, then sixteen, and so on until it is made quite round; except the reinforced part, which in most of the modern work is left with eight sides. In this, however, different gunsmiths exercise their own fancy and taste, both with respect to the number of sides and the length of the reinforced part.

"It is absolutely necessary to the soundness of a barrel that it should be of an equal thickness on every side; or, in the language of the workmen, *a barrel ought to be perfectly upright.* In order to arrive as nearly as possible to this perfect equality, the gunsmiths employ an instrument which they call *a compass.* It consists of an iron rod, bent so as to form two parallel branches, about an inch distant from each other. One of these branches is introduced into the barrel and kept closely applied to the side by means of one or more springs with which it is furnished; the other branch descends parallel to this, on the outside, and has several screws passing through it with their points directed to the barrel. By screwing these until their points touch the surface of the barrel, and then turning the instrument round within the bore, it is seen where the metal is too thick, and how much it must be reduced in order to render every part of the barrel perfectly equal throughout its circumference. This instrument may be made sufficiently long to reach the whole length of the barrel; but it will be more convenient, as well as more exact, to have it little more than half the length; and to introduce it first at one end, and afterward at the other, of the barrel.

"The compass, however, is an instrument so extremely imperfect in its own nature, that it requires very delicate management, even when of the best construction, to show the equality of the barrel to any degree of accuracy." The wonderful nineteenth century, with all the grand results of its active brains and busy hands, lies between the above described rude mechanism and practice and modern machine tools and methods; but, notwithstanding our confident self-satisfaction with our achievements, it is not at all improbable that at the end of the coming century our devices will be cited as evidence of the gross ignorance of our time, and of our consequent utter inability to make a proper selection and adaptation of means whereby to attain mechanical ends.



IMPROVED MILLING MACHINE.

An Improved Milling Machine.

The milling machine, an engraving of which we show herewith, is of the well-known Lincoln type, the main features of which nor the purpose for which it is used need further explanation, as it is a well-known and extensively used type of milling machine. In this case it has, we think, been more highly developed than has previously been attempted. The new features will be readily recognized and consist chiefly in the construction of the outboard support for the arbor, which is clamped to the bed by the single bolt shown in front and which carries a sliding shoe adapted to receive a cylindrical arm of steel, which connects the head with the outboard support, tieing them together and at the same time affording a means by which the spindle and all arbor supports are adjusted vertically together; one screw only being necessary for this.

It will be noticed that there are two different arbor supports, the one shown in position being for the end of a short arbor, while the other, which can be swung down into line with the spindle, is large enough to go over the collars and to support the arbor at any point, as between two cutters for instance. It will be noticed also that the arbor support on the

movable upright has an opening of unusual diameter, and this is provided for the purpose of permitting cutters to be removed from the arbor without disturbing the adjustment of the machine, and cutters up to 4¾ inches diameter can thus be removed from or put onto the arbor.

The hand wheel for moving the platen is placed at an angle, and at the side of the platen, as shown, so that it can be large in diameter and yet not interfere with the platen movement. The feed is by means of a bronze worm running in oil and engaging with teeth formed on the under side of the platen.

The spindle, which is of crucible steel running in phosphor bronze boxes, has a hole entirely through it 11-16 inch diameter, the taper of the hole at the end being the Brown & Sharpe No. 10. Both the front and rear bearings are taper, 3⅛ inches diameter by 4¼ inches long. The table is 12 by 38 inches, its working surface being 8 inches less in length. It feeds automatically 30 inches. The feed is reversible, is automatically tripped in either direction, and has four rates or changes, varying from .011 inch to .067 inch per revolution of spindle.

It will be noticed that the machine is substantially proportioned, it having been its designer's intention to put a liberal amount of metal into it for the purpose of absorbing vibration, and thus conducing to smooth and accurate work. It is built by the Kempsmith Machine Tool Company, Milwaukee, Wis.

▲ ▲ ▲

Screw Testing and Die Making.

I have read with interest the different articles appearing in "The Machinist" recently on screw cutting in the lathe and screw machine and the tools used in the operation. As at different times I have had something to do in this line, perhaps some of the tools and rigs I have seen and used may also be of interest.

Fig. 1 shows an idea for an anvil for a screw measuring micrometer, the *V* in which is first cut of an even depth throughout; it is then placed on an eccentric stud or mandrel and the circumference reduced, leaving a V groove of varying depth. The edges also while on this mandrel are brought up sharp that they may not interfere with the other threads next the one being measured.

Two forms are shown, the one at the right of use only on short screws with the first form of anvil, but with the form shown in Fig. 10 can be used on any length. This gives quite a range of pitches upon which the micrometer can be used without changing the anvil. These are, of course, only for comparing a screw with a standard.

In "The Machinist" of February 3 last, in describing a method of making and testing an accurate tap Mr. McGregor shows a way of making a pitch gage that I have used in a slightly different form, shown in Fig. 3. I saw slits lengthwise in a piece of the form shown and fill them with sheet steel of as near the same grade as that of the mandrel as possible. A thread is then cut over the outside of the mandrel and the thin pieces afterward taken out, when they can be cut up into lengths convenient for use in the shop. This is a good way to make gages for thread tools and gear cutters and many irregular shapes that can hardly be done as well with a file. A tool can be shaped up much easier and quicker than a gage, and by inserting a short piece of sheet steel in this manner a groove can be cut around the mandrel and the sheet steel taken out, forming a fine gage, with clean edges and sharp corners. With a Hendey-Norton lathe a variety of pitches can be cut on one mandrel with very little trouble. I have shown the pieces held in by screws at the ends, but these are hardly needed, as I have very seldom had any trouble with their moving if they fit the slit well. At Fig. 4 is shown a way of mounting such pitch blades. The U pieces between which they are held move to any of the different V's, so that a screw of any diameter may stand in the light. Four blades are let into as many shallow grooves in a pipe and, their ends having been turned while in the threading mandrel to allow a ring to be slipped over them, the whole is clamped between the U pieces as shown. A number of extra blades of other pitches can be kept in the barrel around which the blades in use move, either end of which has a screw plug with a knurled head upon it.

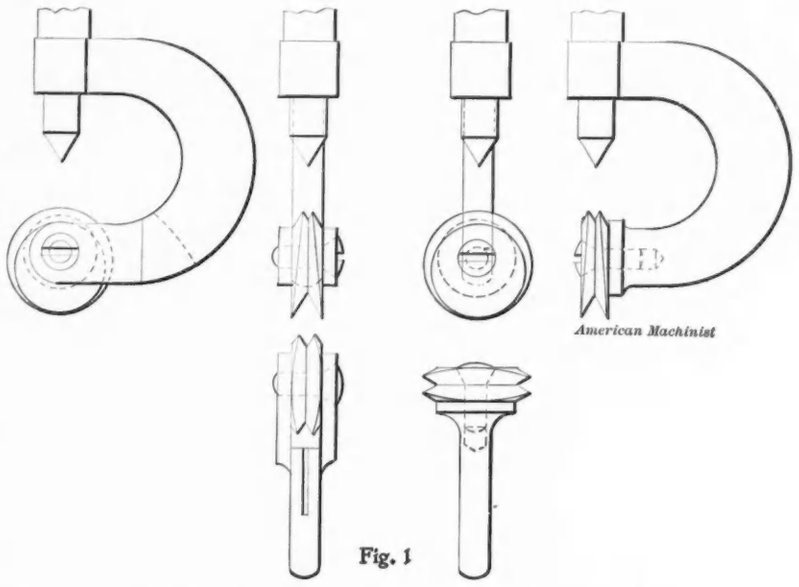


Fig. 1

MICROMETER ATTACHMENT FOR GAGING SCREWS.

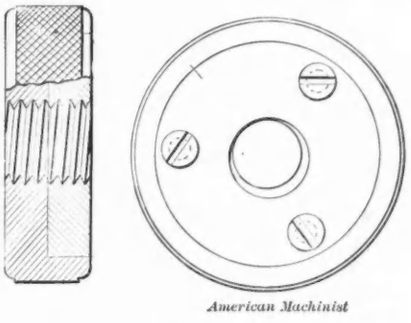


Fig. 2

ADJUSTABLE GAGE FOR SCREWS.

At Figs. 2 and 5 are shown forms of screw gages the adjustment for which is made by removing the part held by screws and packing with tissue paper,

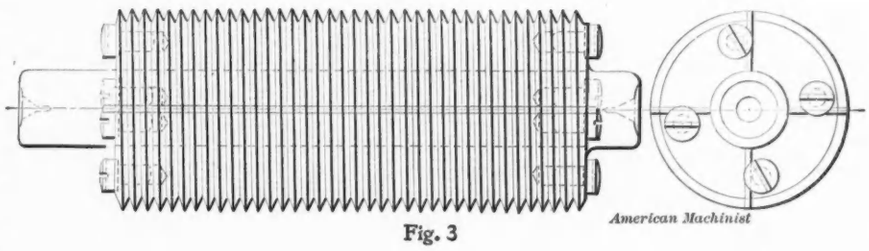


Fig. 3

ARBOR FOR MAKING SCREW PITCH GAGES.

which may be obtained of very even thickness as low as .001-inch, and then if the standard plug is right, or will not enter, the gage can be lapped slightly with a lap having a thread of the right pitch cut upon it and a taper hole, it fitting a lapping mandrel, the lap being split for adjustment. I prefer brass for a lap of this kind, as cast iron is apt to crumble in cutting the thread upon it.

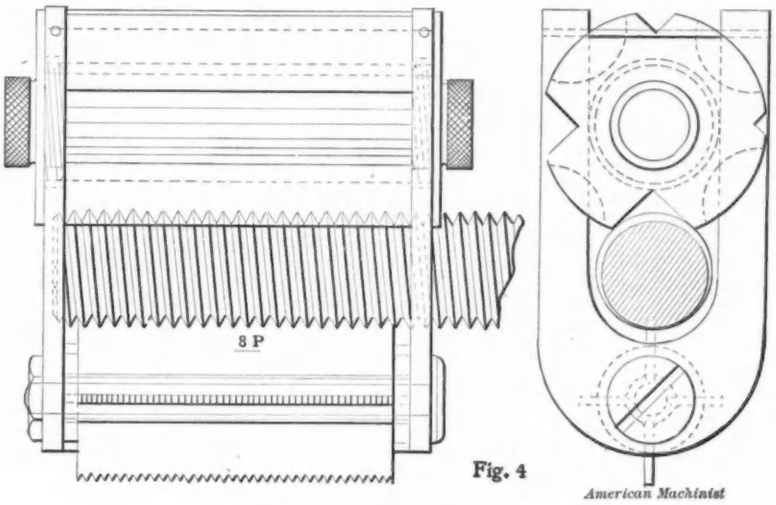


Fig. 4

SCREW PITCH TESTER.

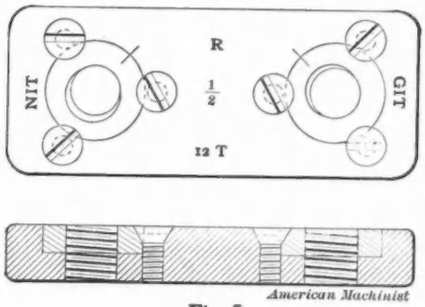


Fig. 5

LIMIT GAGE FOR SCREWS.

Figs. 6 and 7 show forms of the solid die and manner of holding it, and in Fig. 6 the manner of laying out a form which I find gives good service—cutting cleanly and easily.

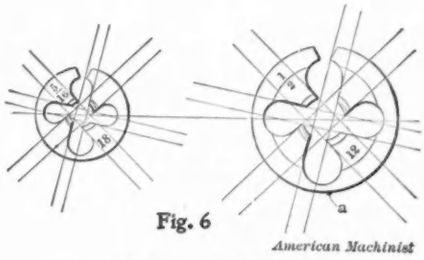


Fig. 6

METHOD OF LAYING OFF DIES.

I make these solid dies by taking a round bar of tool steel and turning the outside a little more than the finish diameter of blanks. The jig used for drilling and tapping serves as a guide, as the blanks must fit that. The bar is of a length sufficient for the number of dies of that size I wish to make. I then mill a V groove the length of the bar thus turned. This groove is for the point of the adjusting screw in the holder, but is not milled deep enough to cut into the clearance hole when it is drilled. It is then placed in the lathe, the center rest adjusted and the blanks cut off of the right thickness. They are then placed in a jig like Fig. 11, which is arranged to drill dies of a number of sizes by substituting hardened tool steel pieces with drill holes properly made in them to guide the drills. After burring and countersinking guide for the shank of a tap is used (not shown) in place of the steel drill guide, the bottom plate also being replaced by one with but a single hole in it of a diameter large enough to allow the tap to pass through. The die blanks are then tapped from the opposite side to that on which they have been countersunk, as the end of a hole at which a tap enters is always made a little larger than the other, however well the tap is guided. The V groove previously milled in the blanks serves to dog them while being drilled and tapped. Next they are placed on a nut arbor, the outside and two faces turned off, leaving enough for grinding. The center of the die is made slightly lower than the outer portion, as shown at Fig. 6. This gives a sufficient surface for grinding without going over the entire faces of the dies. The clearance holes are then opened into the tapped hole and the die is ready for hardening without cutting the V groove through into the clearance hole. The clearance hole opposite the V groove is larger than the others and its center nearer the circumference of the die.

After hardening and drawing, the die is held in a pair of tongs with heavy jaws, and the point of a bunsen flame is blown against the thin portion marked *a* in Fig. 6, and the temper drawn down low enough to prevent breaking. The heavy jaws of the tongs prevent the temper starting in the other portions of the die.

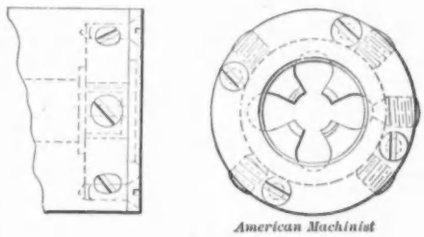


Fig. 7

DIE HOLDER.

The dies are next placed on a threaded arbor and ground on the circumference and the two sides. The faces are now pretty apt to be true with the thread in the die, and they are then placed on a table rest in the cutter grinder or speed lathe and a thin corundum wheel cuts the V groove through. If a very small die a thin copper or brass lap wheel may be used and emery and oil poured on it with a spoon. If the die springs any when it is opened, the faces ground being true

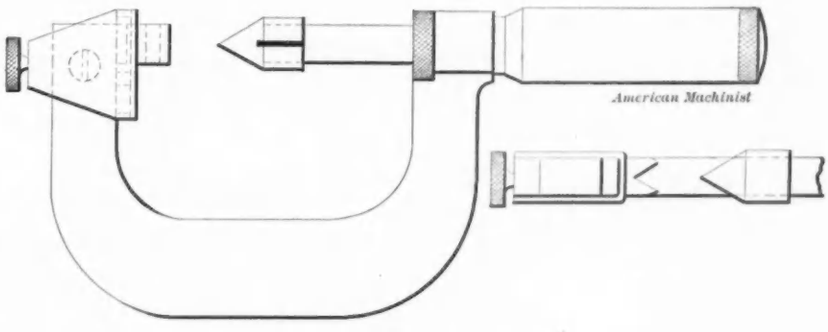


Fig. 8

ATTACHMENT TO MICROMETER FOR GAGING SCREWS.

with the thread, when it is placed in the holder it will be brought to its proper position.

Mr. Surface, in his article in the "Machinist" of February 3 last, speaks of sharpening this form of die with a piece of wire or rod used as a lap in a speed lathe. Lapping is slow business at best in comparison with other modes of grinding, but this manner of sharpening these dies when new and also when dull is good, and at Fig. 12 I show a rig for doing it which I have found quite handy and something of an aid in speed. It is used in a small drill press with emery and oil in the reservoir. The lap being run up and down through the die carries the emery and oil with it and keeps plenty of fresh grinding material at work. The die shown is in a bushing or ring, allowing a great variety of sizes to be used in this way in the rig. Emery sticks can be bought of the right length and diameter and fastened in a brass holder with shellac, water taking the place of the oil and emery in the reservoir. These cut well, but are apt to break. If they could be made with an iron or steel core to be held in the chuck and to stiffen them I think they would work well. A form of lap for dies like Fig. 7, shown at Fig. 13, can be used, and the grinding done by simply moving the lap up and down in the die, the drill spindle not revolving.

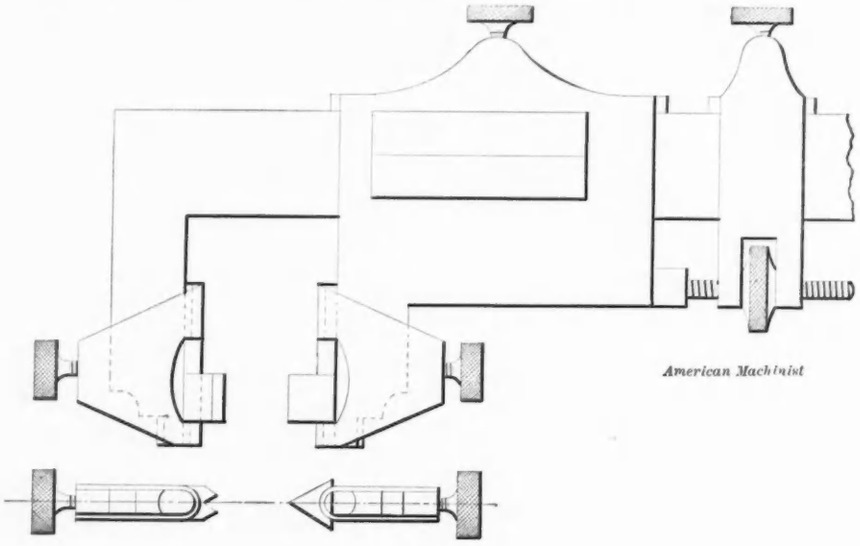


Fig. 9

SCREW GAGING ATTACHMENT FOR VERNIER CALIPER.

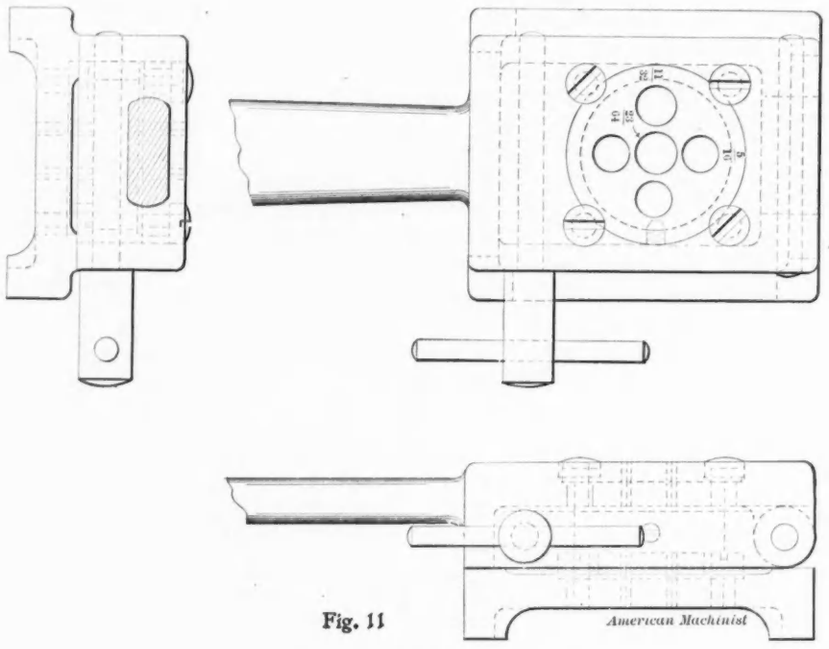


Fig. 11

JIG FOR DRILLING DIES.

At Fig. 8 is shown an attachment that may be used on either a 1-inch or 2-inch micrometer for measuring screws. They can be taken off and put on without disturbing the caliper for ordinary use. Fig. 9 shows an attachment for a vernier, caliper square, etc., for the same purpose.

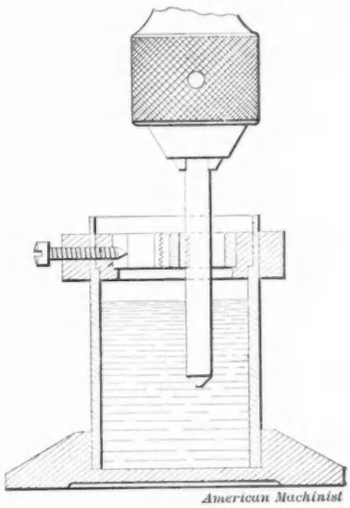


Fig. 12

LAPPING DIES.

There is a form of holder for dies and reamers used in some of the Hartford shops called "floating" that allows a reamer or die to adjust itself true with the hole or screw shank. I have at different times made these dies of machine steel and got good service from them after case hardening them as much as possible.

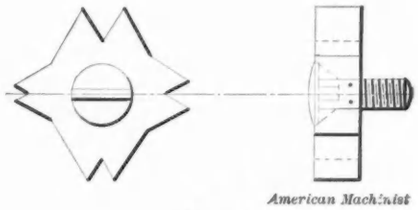


Fig. 15

ANVIL FOR MICROMETER.

There are screw machines—those for making watch screws in particular (automatic)—in which the holder carrying the die is geared up as a screw cutting engine lathe, in order to insure a correct lead in the screws being cut.

MACHINIST.

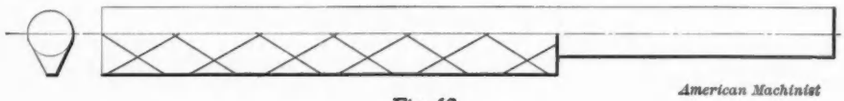


Fig. 13

LAP FOR DIES.

Letters from Practical Men.

A Broaching Job.

Editor American Machinist:

At the shop where I am employed we ran against a little conundrum on a broaching job this year.

It's a bike shop and the cranks are the two piece style. The end of the left crank is turned taper and then flatted tapering on two opposite sides. The right crank is 1⅛ inches through at the broached hole and our punch press is a Toledo No. 75, with a scant 1½-inch stroke. The job reminds me of an advertisement in the "Help Wanted" column a while ago, where some concern wanted a foreman, one of whose good qualities must be to get the best results from the "facilities furnished." I don't mean to say we have the "best results," but the 1½-inch stroke for 1⅛ inch of forged steel is very much of a "facilities furnished" sort of a deal.

One of the tool makers and I got our heads together and the accompanying photographs and a little explanation will give you the results of our collision.

The hole is 7-16 of an inch flat by 39-64 of an inch round at the smallest end, so we drilled a 27-64-inch hole and tried the broach. I got a surprise and now I know more about the power required for broaches than I did before. But first I had better describe the broaching outfit.

The broach is 7¼ inches long, with about 5¼ inches of teeth. The holder is made of two pieces for ease of getting the holes into it. It has four holes through it at right angles to the broach hole, so that a ⅝x7-16-inch bar can be slipped through, and these are so arranged that each stroke of the press leaves the top of the broach at the bottom of a hole. By putting in the bar the broach is driven down at the next stroke, five strokes being required to drive the broach through.

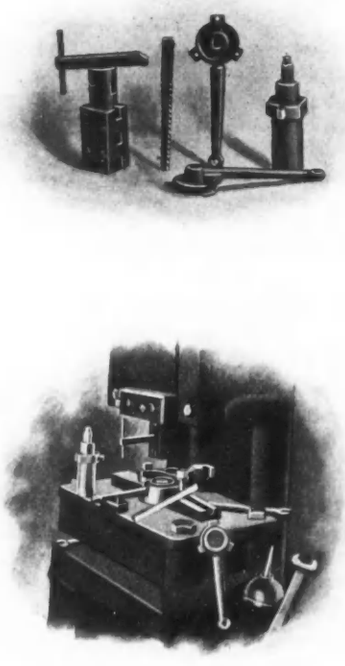
We placed a strap over the crank to prevent it from coming up as the press did, and as the broach is free to slide in the holder it stays in the crank and the holder comes up ready for the next lower hole.

The strap is shown thrown back. It swings on a screw at one end and has a notch at the other to slide under the head of a cap screw. The die that holds the crank is set into an old tube bending die, as shown in the picture.

So far we have only a straight hole. In tapering we use the same holder for the cranks, but put in the taper punch shown and drive it into the crank to a shoulder, thereby getting the holes of a uniform size. This operation is not done at one stroke, of course, but by striking and then screwing down the adjustment of the press and striking again three or four times.

We tried to broach from the round hole at first, but one trial showed us what we did not know about broaching.

The cranks are drilled in a screw bushing jig, with the bush flat ended, so we fixed the lower holder to slide 3-16 of an inch and used an end mill made for the job and cut out one side of the hole. So now we have a walk away for one broach. I do not think we have the best way out of the job, for I can see where



A BROACHING JOB.

we can improve. But time and amount wanted will not warrant doing anything more with it at present.

A. D. McELHONE.

[The photographs sent by our correspondent were too small to show the tools clearly and well, but we have done the best we could do with them.—ED.]

▲ ▲ ▲

No Wrench on the Cone Lock.

Editor American Machinist:

Will someone give me a reason why some lathe builders still persist in making the lock-bolt (connecting the main gear on spindle with belt cone) with a square head to be operated by the tool-post wrench, when a thumb nut or knurled piece answers so nicely? If they still want to use the wrench it would be a good thing to put a hand-hole in gear web or else make it with arms, so that when the bolt is twisted off (which it often is) there would be no need of taking the headstock all apart to get the thing out. Yours truly,

EDMUND BURY.

Easton, Pa.

▲ ▲ ▲

Reboring a Steam Cylinder.

BY CHARLES A. HAGUE.

A broken piston ring had caused the damage. It was just about shutting-down time, when a sharp report, followed by a snapping and rasping as though everything was going to pieces, announced that something had "let go." Upon removing the top head, the cylinder was found to be rutted and scored from end to end and pretty much all round, nearly an eighth of an inch deep in places, although the marks looked to be at least double that. Times were too busy to tolerate the idea of stopping any longer than to put in a spare set of packing rings, which were fortunately on hand. This was acomplished in a few hours in the night, and the engine was started up on time in the morning as usual.

A holiday being in sight, it was decided to prepare to re-bore the cylinder and put in a new "bull ring" and packing. Although the piston portion could be easily managed, to bore the cylinder and have the engine ready for operation in a single day would require some careful preparation and an entire absence of hitches and delays, so everything that could be foreseen was done in advance.

The engine was of the inverted, vertical type, the cylinder 36 inches in diameter and 60 inches stroke; the piston was of the box form, fitted with a bull ring in two sections, with two packing rings. All that was necessary in preparing the piston was to measure the cylinder as it was before the cutting, then allowing for the amount to be bored out in removing the scores, make a new bull ring, whose inner circumference would fit the piston body, and whose outer diameter would correspond to the re-bored cylinder, and to this new bull ring have fitted new packing rings.

This work upon the piston rings could all be done in advance, the head having been taken off of the cylinder one night and the necessary measurements made, the exact size of the new packing rings giving a gage to which the cylinder was to be finally bored. Every other possible preparation that could be thought of and made in advance was looked carefully after, leaving nothing but the actual work of setting the tools and boring the cylinder. A suitable bar was found which was used for repair work. It was of good size, and had a traveling head moved along by means of a feed screw, which in turn was actuated by the well-known

"star feed," the screw being let into a grove in the side of the bar, and engaging with a nut attached to the boring head in the usual manner, the boring tools being of course secured in the rim of the head.

At one end of the boring bar, the upper end in this case, there was fitted a large spur gear, but so arranged that it could be readily moved along the bar as different work might demand; this gear was driven by a small pinion, also adjustable for different needs, and attached to a small shaft parallel with the boring bar. The whole driving mechanism and the end of the bar were strongly supported by a cross-shaped framing of castiron, which could be secured to a cylinder by using the regular cylinder head studs. This left everything clear within the cylinder, so that the counterbore could be cleaned up by proper adjustment of the cutting tool when the boring head was at the upper end of the cylinder. It was found that it would be desirable to employ bevel gears, so as to obtain a horizontal pulley shaft, and therefore a couple of brackets were fitted to the boring-bar frame to carry the second shaft. All of this, and other work needed to prepare the bar for immediate use upon this particular cylinder, were done in advance, and everything was ready for prompt action.

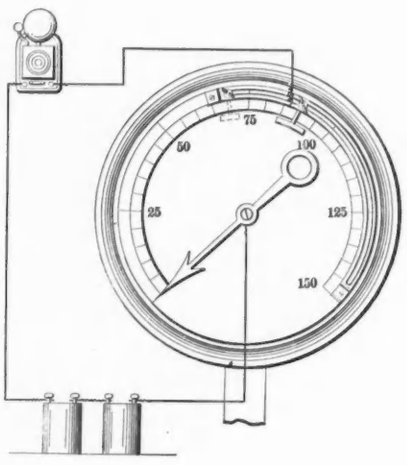
The lower end of the boring bar was supported upon a steel center like a lathe center, fitted tightly into a cast-iron block, the block taking the place of the stuffing-box gland. The lower cylinder head, the entablature, and the framing being undisturbed, of course the alignment of the bore of the cylinder after finishing was assured, the upper end of the bar being carefully set by means of calipers with the old counterbore at the top. The counterbore at the bottom of the cylinder was first made by setting out the cutting tool at the lower port, care being taken to have it just a little larger than the proposed new diameter of the working part of the cylinder; then the upper counterbore was made also of the proper diameter and depth, and there was then nothing to do but to carry a plain clear cutting from one counterbore to the other. This was done in two cuts. The roughing cut was made with three cutters and went through with great rapidity; the finishing cut was made with one broad-nosed tool, also with rapid feed, but taking out very little stock. The first cut went through in 132 minutes, and the second in 164 minutes; the first with the cutting edges at the rate of 19 feet per minute each, and a moderate feed, the second at 12 feet per minute with about a three-eighths feed per revolution. The stock in the cylinder casting being of good quality, the newly made bore was a beauty. It took three hours in the morning to get ready for operations, one hour to finish the counterbores, five hours to bore the cylinder proper, and two hours to put the engine in order for running, the piston packing having been fitted while the boring was going on.

The boring bar was driven during this work by a small steam engine hired for the purpose. Upon the shaft of the spur pinion, already referred to, was a bevel gear which in turn meshed with a pinion keyed to a second shaft, and upon the end of this second shaft was a belt pulley. Power was transmitted from the engine to this pulley. A small steam engine, about 6x12 inches, furnished with steam from the regular boilers, and bolted to the engine room floor, provided a steady and reliable source of power, and the work went smoothly along, without interruption or mishap, to a completely satisfactory conclusion. The boring bar was removed, the cylinder cleaned out, the piston put into place, the head put on, and in just about eleven hours from the start steam was turned on, and the newly bored cylinder was doing work. It had been necessary to make some small bearings for the driving mechanism of the bar, but altogether the incidental expenses were very light, and in proportion to the benefits realized not to be considered.

▲ ▲ ▲

A Steam Gage Alarm.

As the accompanying cut, which is from a recent patent, suggests, it is a simple matter in these days of electric call bells to make a steam gage instantly announce when the boiler pressure passes either above or below any pre-determined points, and, so far as such service is desirable, it is not easy to see why it has not been already more generally adopted. In the arrangement here shown a curved slotted plate is permanently fixed to the face of the gage, and an inwardly projecting T piece is adjustably fastened to it by a bolt and thumb nut. The bell and battery being provided, and both the T piece and the gage pointer being properly insulated from the body of the gage, one wire is connected to the former and the other to the latter. The alarm being used for high pressure, and the T piece being set at the point where the alarm is to occur, when the pointer comes in contact with the T piece the circuit is completed and the bell rings. If the alarm was required for low pressure also another bell of different tone might be used.



ELECTRIC STEAM GAGE ALARM.

▲ ▲ ▲

Indexing Tools.

Mr. Burlingame's article on "Tool Books," published in our issue of February 17, leads the Fitchburg Machine Works to send us samples of their forms for indexing taps and counterbores, of which we reproduce enough to show the plan. There can be no doubt that these indexes save a considerable amount of time and occasionally save duplication of tools which, without the indexes, would sometimes be overlooked.

▲ ▲ ▲

Technical Publications.

GERMAN UNIVERSITIES AND THE DEMANDS OF THE TWENTIETH CENTURY. By Professor A. Riedler, Berlin, 1898.

In matters educational Germany has long been looked upon as the world's Mecca, where all things are as they should be, and whither students flock from all parts of the world. There is, however, in Germany a growing conviction that after all the German educational system does not meet the demands of the times, and still more that, as at present organized, it is ill adapted to the requirements of the immediate future. The subject is discussed at length by Professor Riedler in a pamphlet which has been sent to us, in which he argues with great force that the existing universiti s do not prepare their pupils for the practical needs of life. He takes a high position regarding the value of engineering education as a means of intellectual culture, and proposes a thorough reform of the German university system by the addition of technical departments to the universities. He believes that the reform would lead to much more effective scientific and technical education and to a higher social appreciation of engineers and architects than is now the rule in Germany. In case this union cannot be brought about he advocates the addition of economic and general scientific subjects to those now taught at the German technical colleges.

PRACTICAL SHOP TALKS. By Fred H. Colvin. 144 3½x6 inch pages. Cloth. Locomotive Engineering. 50 cents.

This book deals with the problems of shop management—the management of

2-22-'97. L-308

FITCHBURG MACHINE WORKS.

COUNTERBORES.

DIA. IN.	32	16	8	DIA. STEM.	DIA. IN.	32	16	8	DIA. STEM.
.....	.....	3	.....	$\frac{1}{8}$	1	.....	.....	5	$\frac{3}{4}$
.....	.....	.....	2	$\frac{1}{8}$–$\frac{5}{32}$	1	21	.....	.....	$\frac{7}{8}$
.....	9	.....	.....	$\frac{5}{32}$–$\frac{7}{32}$	1	.....	11	.....	$\frac{5}{8}$
.....	.....	5	.....	$\frac{5}{32}$–$\frac{3}{16}$	1	.....	.....	6	$\frac{5}{8}$–$\frac{3}{4}$
.....	.....	.....	3	$\frac{1}{8}$–$\frac{3}{16}$–$\frac{13}{32}$	1	.....	13	.....	.....
.....	.....	7	.....	$\frac{13}{64}$–$\frac{1}{4}$–$\frac{5}{16}$	1	.....	.....	7	$\frac{3}{4}$
.....	.....	.....	4	$\frac{1}{4}$–$\frac{9}{32}$–$\frac{13}{64}$–$\frac{5}{16}$	1	.....	15	.....	$\frac{7}{8}$
.....	17	.....	.....	$\frac{5}{32}$	2	.....	.....	.....	$\frac{5}{8}$

2-15-'97. L-302.

FITCHBURG MACHINE WORKS.

TAPS.

DIA. IN.	32	16	8	*V THR.* RH	LH	*SQ. THR.* RH	LH	*WORM THR.* RH	LH
....	....	....	1	.....	.....	.....	.....	.....	.....
....	5	....	....	32	.....	.....	.....	.....	.....
....	....	3	....	.....	.....	.....	.....	.....	.....
....	7	....	....	.....	.....	.....	.....	.....	.....
....	....	....	2	20-24	.....	.....	.....	.....	.....
....	9	....	....	18	.....	.....	.....	.....	.....
....	....	5	....	16-18	18	.....	.....	.....	.....
....	11	....	....	.....	.....	.....	.....	.....	.....
....	....	....	3	14-16 20	14	.....	.....	.....	.....
....	....	7	....	14-16	14	8	8	.....	.....
....	....	....	4	12-13-16	14	.....	10	8	8
....	$16\frac{1}{2}$	....	....	12	.....	.....	.....	.....	.....
....	....	9	....	12	.....	8	.....	.....	.....
....	....	....	5	10-11-12-14	10- -14-16-	8	8	6-8	6-7
....	....	11	....	10 12	.....	8	$8\frac{1}{4}$	.....	.....
....	....	....	6	10-12-14-16	10-14	8	8	8	5-8
....	....	13	....	10 14	14	.....	.....	.....	.....
....	....	....	7	9-10-12-14-	10-12-14	6	6	8	.....
....	....	15	....	10- -14-16	.....	6	6	.....	.....
1	....	....	....	8-10-12- -16	14	.....	5	8	.....
1	....	1	....	.....	12	4-5s-6-	6	.....	.....
1	....	....	1	7-8-10-12-14	12	.....	4	.....	.....
1	....	3	....	12	.....	4^1	$4\frac{1}{2}$-5-6	.....	.....

S means special, as 5s means 5 thr. but special.
Exponent means lead as 4^1 means 4 thr. but 1 inch lead.

Sheet 326.

FORMS USED BY FITCHBURG MACHINE WORKS.

shops and men by proprietors, superintendents, etc., and the management of proprietors, superintendents, etc., by shop men. These questions are treated in the easy, readable and even colloquial style dear to the hearts of some readers and utterly misunderstood or detested by others, apparently in accordance with individual temperament. For instance, the author attacks the superstition regarding the formation of ridges in a cylinder if the boring bar is allowed to stop, and devotes a chapter to telling how "Dick" worked it and how he cured himself. There is undeniably a large number of shopmen who prefer their shop literature in that style, but so far as we can ascertain the vast majority of our readers would prefer us to say simply that "boring tools can be stopped during a cut through a cylinder without danger of objectionable ridges being formed," only if we were to say so we should expect the statement to be questioned. The book deals also with such subjects as responsibility of mechanics, shop rules, salaries of men in responsible positions, apprenticeship, financial management of manufacturing enterp ises, etc., and in a manner which will interest and appeal to many who cannot be induced to read plain statements of fact or simple, unembellished arguments.

AMERICAN ELECTRICAL DIRECTORY AND BUYERS' MANUAL. E. S. Powers, Monadnock Block, Chicago, and Havemeyer Building, New York. Quarterly. Price, per annum, $4.

This publication is a continuation of the Standard Electrical Directory. Its two chief features are a list of electric light central stations, with an outline statement of their capital stock, officers and equipment, and a buyers' finding list. The caption of this list states that no pay is accepted for the insertion of names, but nevertheless we find some serious shortcomings. But one type of boiler—the water tube—is given, and under this heading we find several makers who are not known to us as makers of this type of boiler. All metal working tools are classified under a single heading, and the list is absurdly incomplete. It does not contain a single manufacturer from Worcester, Mass., and but one each from Philadelphia and Cincinnati.

GLASS BLOWING AND WORKING FOR AMATEURS, EXPERIMENTALISTS AND TECHNICIANS. By Thomas Bolas, F.C.S., F.I.C. 209 5x7 inch pages. 104 illustrations.

In this book the author has given what constitutes a practicable and laboratory workshop guide to glass blowing and working with the blowpipe, and as reasons for the various operations performed and some discussion of the underlying principles are given the book is in a true sense educational. Tools and implements employed are fully illustrated and described, and the book is interesting as well as valuable technically. Truslove & Comba, 65 Fifth avenue, New York.

▲ ▲ ▲

It is stated that the movement which had been arranged by the International Association of Machinists to begin May 1 for the establishment of an eight hours' working day has come to an end, owing to the very small vote of the membership upon the matter. Less than one quarter of the members voted upon the question one way or the other.

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Cranes, Shop Floors and Storage.

The traveling crane has made much change in shop practice, and while its function is not to be belittled we are sometimes inclined to think that its advent has not been altogether a blessing, and that in many shops a state of things ensues in consequence of its presence which would not otherwise prevail. Mechanically it is a really beautiful sight to see an enormously heavy casting picked up without the slightest evidence of effort and put down in precisely the right place. That is what the crane is for. It is not so beautiful to see the same crane pick up casting after casting, and apparently everything that it can get hold of, and put it in precisely the wrong place.

Of course the fact that it does so is no reproach upon the crane itself, but upon the management which permits and even requires it to do what it should not. We have always had an impression that the total contents of a shop, with little exception, should be comprised under the three classes of tools, men and work under way. If the shop is for work what reason can there be for the presence in it of anything else, and what can the presence in it of anything else accomplish in the way of enhanced production? Nothing could be more absurd, in case every tool and every man were doing their best, to infer that the shop whose floor was clear and clean, which allowed perfect freedom of movement and full swing around every job, with absolutely unobstructed light in every direction, was doing less than another shop which has piled within it everything for which it has any prospective use in the distant future or which it may have used or worked on long ago. It was once necessary to keep the floor clear so that trucks and rollers would have room to travel, and so that everything could be got at with crowbars and levers and tackle blocks. The cranes have changed all that. They care little, or, in fact, not at all, for floor obstructions. They do not have to go around anything. They can lift whatever they carry high enough to clear, and, as far as the cranes are concerned, for the general handling of material, floor room is not requisite. In consequence of this there is quite a disposition in many shops which we have looked into to use floor space for storage purposes, which would not have been so used in the olden time. It might have been inferred, and it certainly should have been hoped, that the vastly increased facility in lifting and moving should have given us clearer floors, but the result is often quite the reverse, and in this particular it cannot well be regarded as anything but a move in the wrong direction. We can speak quite feelingly on this general subject from extended experience inside the shop. To our eyes the crowded and cluttered up shop is inevitably suggestive of discomfort, inconvenience, delay and constantly wasted labor. The sign of humming prosperity is in the shop that is at all times free from extraneous material, or as free from big dirt as small dirt.

The subject of the storage of material in its progress through an establishment is one which has not received, except in perhaps a few instances, the consideration which it deserves. There have been great schemes of shop arrangement to avoid all unnecessary handling of material, as though the handling of material was the most costly thing in the world, when, at the same time, we claim that our facilities for handling have been enormously increased. The scheme of avoiding the handling of material, and of passing it along by the most direct route to the next process which awaits it, is in absolute perfection in the packing house of the Armour Company; and in any roller mill, which takes wheat from one car and loads barrels of flour upon another car, it is seen in its glory, because in these each succeeding operation can be made to keep time with that which precedes it, and there is not the slightest obstruction of the continuous flow, and no accumulation of material anywhere. It is impossible to run any machine business, any steam engine works, for instance, in the same way. The foundry and the blacksmith shop cannot and should not keep exact pace with the machine shop, but must necessarily be always ahead of it, and the machine shop floor is not the place for the accumulation of the waiting material. We would not have far to go for an object lesson. We could find an existing shop which is built on the straight line principle, with cupola and stock of pig iron at one end and with a railroad track at the other for taking away the engines, and there is a constant and unfailing flow of the big engines at the west door, but the impossibility of synchronizing the shop work is evident to anyone who passes through it. There is an accumulation of material everywhere, the floor is outrageously crowded, and it is not easy or comfortable for even an unoccupied person to pick his way all through. In this particular establishment it seems certain that considerable more handling of material, by taking it to a place of storage and then out as wanted, would be a great improvement. The Worthington Pump Works, as is well known, comprises a machine shop in Brooklyn and a foundry a dozen miles away, with water carriage between. The arrangement is, of course, for a large concern suggestive of inconvenience, but it is not the evil that it might be supposed. It has developed a complete system of casting storage, and there is not the slightest sign of using the floors of the machine shops for the purpose.

▲ ▲ ▲

Last week in our Commercial Review we stated that the Driggs-Seabury Gun and Ammunition Company had taken the plant of the New Haven Manufacturing Company and the F. L. Gaylord Foundry, Ansonia, Conn. We learn, however, that at least so far as the New Haven Manufacturing Company is concerned the report is untrue. The New Haven Manufacturing Company is doing some work for the Driggs-Seabury Company, and has sold them some tools, but has not sold nor is thinking of selling out to anyone.

▲ ▲ ▲

A question having arisen as to the proper name of the shifting bolt which locks the cone-pulley of a lathe to the large spindle gear, we addressed inquiries to a number of builders of lathes and find

it is by them variously called "Lock-bolt," "Cone-lock" and "Cone dog-bolt." The preponderance seems to be in favor of "cone-lock," which term seems also the most clearly descriptive.

▲ ▲ ▲

It is stated that the Cramp establishment in Philadelphia has taken an order for naval vessels for the Russian Government.

▲ ▲ ▲

Next week's issue of the "American Machinist" will be devoted to showing, chiefly by pictures, what our machine shops and the men who work in them are doing by way of preparation for carrying on war.

▲ ▲ ▲

We are informed that the Dixie Company, of Atlanta, Ga., has been reorganized under the name of the Southern Industrial Publishing Company, its president being Mr. T. H. Martin, who has been and will continue to be the editor of "Dixie."

▲ ▲ ▲

The electric elevator machine for the London Underground Railway is to be shown at the Electrical Exposition to be held at Madison Square Garden, commencing May 2. The London machines of this type are said to be the largest elevator machines ever built, and were built by the Sprague Electric Company.

▲ ▲ ▲

Our esteemed contributor, Dr. Thurston, one of the very few survivors of the crew of the original Monitor, offers his services to his country in its present emergency. Very few of the veterans of the last war can participate in the one now on our hands, and not one can offer probably more efficient and more needed service. As a consulting or even an active engineer a man more fit could scarcely be suggested.

▲ ▲ ▲

Personal.

Acting Assistant Engineer George A. Kolb, U. S. N., has been appointed to the relative rank of ensign on the "Panther."

Assistant Engineer J. H. Hudgins, U. S. N., has been detached from the "New Orleans" and ordered home to await orders.

Chief Engineer W. F. Worthington, U. S. N., has been detached from the "Yankee" and ordered immediately to the "Sterling."

Assistant Engineer B. K. McMorris, U. S. N., has been detached from the "New Orleans" and ordered home to await orders.

We welcome personal items regarding men connected with the machinery business. Kindly contribute what you can to this department.

Acting Passed Assistant Engineer George W. Campbell, U. S. N., has been appointed to the relative rank of lieutenant on the "Panther."

Chief Engineer R. G. Denig's U. S. N. order detaching him from the "Constitution" and ordering him to the "Yosemite" has been cancelled.

Passed Assistant Engineer W. B. Day, U. S. N., has been ordered to Washington, for examination for retirement, and then home to await orders.

Mr. Harry M. Griffin has resigned his position with the Stanley Manufacturing Company, of Lawrence, Mass., to take charge of the turret lathe work at the American Ordnance Works, of Lynn, Mass.

T. T. Wood, who has been superintendent of the Belle City Malleable Iron Company, of Racine, Wis., has resigned to form a new company to carry on the same business in the same place. Mr. Wood will be manager of the new company.

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Obituary.

William G. Creamer died at Brooklyn, N. Y., on April 22. He was said to be the inventor of the first brake which put the control of the train in the hands of the engineer. The date of his invention was 1856. Mr. Creamer was seventy-two years old.

Adolphus Bradley died on April 20 at Bristol, Conn., seventy-three years old. At the age of sixteen he began clock making for Levi Smith, the pioneer clock maker, and at his death was the only survivor of the colony which made Connecticut famous.

Thomas Ashworth, eighty-three years old, died in Forestville, Conn., April 21. He was a manufacturer of wire for half a century, and closely connected in business relations with the manufacturers of brass and copper in Waterbury and the Naugatuck Valley.

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Foreign News Notes.

The sum of 500,000 francs has been voted for the improvement of the docks of Naples, Italy.

The sum of a million and a quarter dollars is to be spent in the near future for the improvement of navigation on the River Parana, Argentina, so as to enable vessels of large draft to reach Rosario.

There is need of new and improved machinery in the mining fields of Peru, among others being that of dredgers to reach the beds of the rivers where there are large deposits of gold. These are at present worked by the most primitive means.

The Sud de Santa Fé and Cordova Railway Company, of Argentina, have obtained concessions to build a branch line from Venado-Tuerto, on their present main line, to Rufino, in the Province of Cordova, a distance of about fifty miles.

British consuls are calling attention to the fact that there is a good opening in France for agricultural implements, cutlery and iron ware. We have to compete closely with the Germans for this market, and it may be well to draw attention to the fact that German manufacturers are keenly alive to the fact that duty in France is almost always calculated on the gross weight, and they manufacture a lighter grade of goods for that market.

A report of Germany's trade with Venezuela shows a marked decrease in some directions. For instance, in 1893 her exports to that country of rails was $95,000; last year it was only $17,136; of raw iron goods there was a decrease during the years named from $238,000 to $95,200; in 1893 her exports of bridge material were valued at $23,800; last year none were reported; under the heading of guns there was a decrease from $428,400 to $23,800, and of cartridges from $214,200 to $2,618; and, lastly, in 1893 Germany shipped to that country $47,600 worth of railway cars, and last year none. To overcome this state of affairs to which Germany will not submit if she can help it, there is strong talk of reciprocal relations being established between the two countries, and, in fact, between Germany and all the South American countries.

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Commercial Review.

NEW YORK, Saturday Evening, April 23, 1898.

MILL AND MACHINISTS' SUPPLIES.

To whatever extent the war excitement may have influenced the supply market at the time of our last report upon it, four weeks ago, its depressing influences upon regular trade are now most apparent. It is especially within the last week or two, in fact, within the last three or four days, that the results of public disquiet seem to have been most plainly realized. The experience of a material curtailment of ordinary trade is yet far from being universal, but it is quite general.

It is unquestionable that a state of actual war now exists, and business men are completely at sea as to the future. They are, however, by no means demoralized, and apparently are less despondent than during the political campaign of 1896. The present tone of the market, though perplexed and hesitating, seems, as yet, too much controlled by exhilarating spirits to be depressed.

There has been more or less buying of machinists' supplies for the manufacture of war material, but within the scope of our inquiries the amount of trade attributable, either directly or indirectly, to military preparation has been comparatively insignificant, and the temporary

benefits conferred by the approaching war have by no means compensated for the injury it has done to regular business.

The general supply houses of this city with which we have communicated have been filling but few orders of even a remotely military character. Possibly with some out-of-town manufacturers the case may be otherwise.

We learn, indeed, that certain manufacturing companies have received important Government orders for twist drills. A representative of one of these concerns mentions the names of several navy yards from which orders have been received, and we understand from him that at the time they were taken his trade reached about the highest point of activity it has ever known. Still, he deplores the effect the war will have upon business.

The representative of a company which manufactures and sells to the trade sundry lines of small fine tools informs us that although business has been good up to about the present time, there is now noticeable a tendency upon the part of dealers to retrench, by so curtailing their stocks that they will not be caught with more on hand than they can dispose of if there should come a stagnation of business.

Certain supply companies which handle parts of bicycles in connection with their other lines report an active demand for these at present. One of them says that a call for tools for bicycle work comes with it. The other states that the bicycle shops stocked up with twist drills, etc., last month.

The public disquiet has affected orders for power transmitting machinery somewhat, but according to the reports of several concerns the falling off has been little. Some sales have been made for military work; for instance, to various navy yards.

One important contract recently placed in this neighborhood is that let by the New York Sugar Refining Company to the George V. Cresson Company for about $20,000 worth of shafting, including hangers and other attachments.

PHILADELPHIA REPORT.

Machine shops in Philadelphia are well employed, and some complain of a scarcity of good men. One of the largest shops doing general engineering work is promising delivery at eight months, and one of the large tool houses has of late refused contracts on account of being already full. Government work is being done in a great many shops, but is a small percentage of the work on hand, and gives little comfort. Activity extends to shops not doing Government work. Night work—at least, evening work overtime—is common. The Government work is mostly on gun carriages, which is understood to mean that the progress on guns is in a much more forward state than on the mounts. In fact, a great many guns are waiting for mounts.

The Baldwin Locomotive Works have 5,200 men on the pay-roll, the largest number in the history of the works, and there, of course, Government work cuts

Continued on page 37.

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Business Specials.

Gear wheels, gear cutting. Grant; see page 18.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Gas engine designer wants to change. Box 214, AMERICAN MACHINIST.

Iron foundry foreman wishes position; machinery, heavy and light; first-class ref. Box 219, AM. MACH.

Gen. mach. desires pos. as foreman; mast. mech. or eng.; wide exp.; reliable; efficient. Box 226, AM. MACH.

Wanted—A position as supt. mch. works, by a first-class M. E.; best ref. Address Box 230, AM. MACHINIST.

Experienced mechanical d'ftsman, tech. graduate, references, desires position. Box 235, AM. MACHINIST.

A shop superintendent of one of the most successful turret lathe builders desires a change; nine years in present position; best ref. Box 229, AM. MACHINIST.

If you want an experienced, systematic, up-to-date gen. foreman or shop supt., who understands his business and attends to it, address Box 231, AM. MACHINIST.

A1 mech and successful designer; educated; of broad experience in light and medium work; up to-date; resourseful; energetic; wishes position of some responsibility. Box 460, Rochester, N. Y.

Draftsman, American, of 9 years' experience in various shops and 3 years as draftsman; prefers auto machine or developing invention; good reference from last employer. N. Y preferred. Box 236 AM MACH

Head foreman of machine tool building company desires a change; will accept position as foreman or assistant superintendent; familiar with modern machine shop methods; held present position nearly ten years; habits and reference O K. Box 227, AM. MACH.

Tech. educated mech. eng., 10 yrs. exp. as dr'ftsman; gen. work; specialist on steam boiler designing; chief dr'ftsman for 4 years; desires pos. here or abroad as designer or supt. boiler shop or asst. supt. gen. mach. shop; experienced estimater; ref. Box 232, AM. MACH.

Wanted—Position as supt. of machine works or factory, by a first-class mechanic, 34 years of age, good draftsman, splendid executive ability, of 18 years' experience in general machine work; for the last three years held a responsible pos. as chief engineer of a large plant; best of reference. Box 213, AM. MACH.

Help Wanted.

Wanted at once 50 first-class tool makers. Driggs-Seabury Gun & Ammunition Co., Derby, Conn.

Wanted Draftsman—A young man for detail drafting on light machinery. Address Box 211, AM. MACH.

Wanted—A first-class general pattern maker for mining machinery who can manage several men Address Tampa, care of AMERICAN MACHINIST.

Wanted—A mechanical draftsman, experienced in high speed steam engine work; must be competent to design; permanent position. Box 221, AM. MACH.

Wanted—An expert commutator builder; only a thoroughly first-class mechanic need apply; state years of experience, where last employed and reference. Address Box 212, AMERICAN MACHINIST.

Wanted—By a New England machine tool mfg. company a man to take entire charge of their foundry; must have good executive ability and be thoroughly familiar with details; state age, experience and salary expected; give ref. Address Box 216, AM. MACHINIST.

Wanted—First-class, practical draftsman, with inventive ability, experienced in designing of machine tools, jigs, fixtures etc; must be quick, accurate and industrious; state experience, wages wanted, and give references Address Box 210, AMERICAN MACHINIST.

Wanted One or two first-class milling machine men and tool makers; only those used to fine jig work need apply; also a first-class mech'l draftsman, one used to Patent Office drawings preferred. Apply, with references, stating ability and where last employed, to H. M. P., Beverly, Mass.

Wanted—A foundry foreman who is well up in modern foundry practice and understands how to produce good work economically; none but strictly first-class men need apply; in writing state age, experience and salary expected; also give references. Address Box 222, AMERICAN MACHINIST.

Wanted—A first-class machinist for light work; must also be expert at soldering brass, etc. Inquire at 115 Plymouth street, Jersey City.

Wanted—A rapid detail draftsman on engine work and general machinery. Address, with full particulars, Box 228 AMERICAN MACHINIST.

Wanted—Machinist, with experience as manufacturer of mach. tools, and can purchase interest in shop centrally located. Address Box 233, AM MACHINIST.

Wanted—A man who thoroughly understands reading drawings, of good executive ability and business training. Address, with ref., Box 234, AM. MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Book, Dies & Die Making, $1. J. L. Lucas, Prov. R. I.

For Sale—Kit of pattern makers' tools, little used. Box 225, AMERICAM MACHINIST.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Emery Wheel Dressers; send for sample and price. Manufactured by Geo H. Calder, Lancaster, Pa.

Designer of special mach'y; ord., torps.; facilities for quick drawing, tracing, orders. Brady, 253, B'way, N. Y.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Advertising Novelties Wanted—We will buy patents, manufacture for patentee or on a royalty, good advertising novelties Address P. O. Box 125, Erie, Pa.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

If you use Brass, Bronze or Composition Castings write to us for prices; satisfaction guaranteed on all orders undertaken. James J. McKenna & Bro., 424 & 426 East Twenty-third St., New York. Established 1833.

The advertising department of the American Machinist has on hand 20,000 draftsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

IMPLEMENT FACTORY.

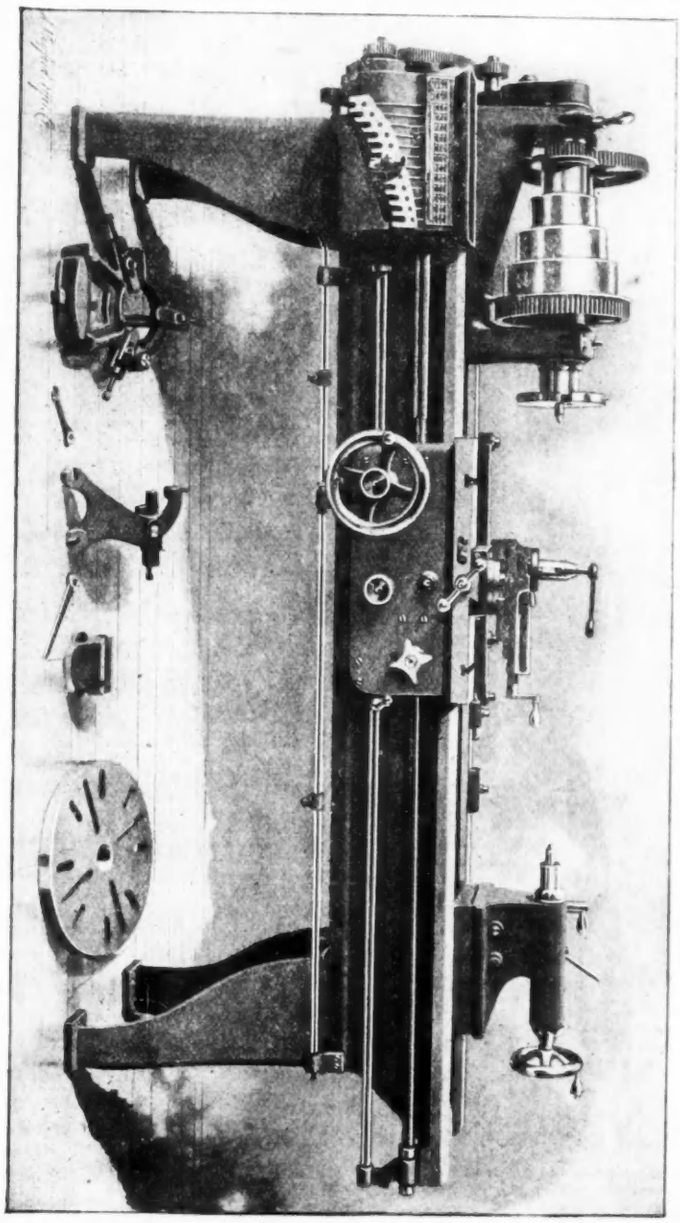
Wanted.—Tech. director able to take the entire manag ment of an implement factory in Ger any. **None but perfectly competent men need apply.** Applicants familiar with the manufacture of spiral drills prefered. Address, with copy of testimonials and particulars as to former positions, etc., salary expected, H. R. 40, care of Rudolf Mosse, Gera, Reuss, Germany.

The Fellows Gear Shaper

Plares gear teeth theoretically correct. The cutter is a universal one. On cutter only for a 12-toothed pinion, a 200-toothed gear, an internal gear, or a rack. And "this cutter is correct." Allow us to prove this to you.

The Fellows Gear Shaper Co.,
Springfield, Vermont.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. R. PIERCE, Secretary and Treasurer.



20 in. x 8 ft. Hendey=Norton Lathe.

....

ALL these Lathes have the Norton Screw Cutting feature. All the different threads and feeds in daily use obtained by moving the handle in gear box from one notch to the other. All sizes but the 32 in. fitted with our Automatic Stop Rod for carriage. By its use you can cut threads to and from shoulders and always have the carriage stop in the same place. All lathes have the reverse motion in head, operated by lever at side of apron. By this you reverse the carriage only, which is all that is necessary in cutting threads.

These attachments mean a great saving of time and labor.

THE HENDEY MACHINE CO.,

Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:

PACIFIC TOOL AND SUPPLY CO., . San Francisco, Cal.
J. W. CREGAR, . . Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:

SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
ADOLPHE JANSSENS, ... Paris, France.

Continued from page 30.

no figure. There is no doubt that but for the war, industry is in excellent shape.

The Russian contract with the Cramps is for four ships; some reports say six.

A constant movement of tools to Europe—especially Germany and Russia—is in progress. These are of all kinds, but some notably heavy and highly specialized machines are included. A good many boring mills are going to Germany, which is another evidence that our Teutonic friends know and appreciate a good thing. Tool builders here consider that this movement is likely to increase rather than diminish.

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Quotations.

NEW YORK, Monday, April 25.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	10 00 @ 10 50
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 25 @ 10 50
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock. Common, 1.07½ @ 1.10c.; refined, 1.15 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.15 @ 2.20c., according to quantity.

Copper—Carload lots: Lake Superior ingot, 12¼c.; electrolytic, 12c.; casting copper, 11¾ @ 11⅞c.

Pig Lead—Carload lots, 3.65c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 14.70 @ 14.80c.

Spelter—Carload lots, 4.25 @ 4.30c., New York delivery.

Antimony—Cookson's, 8¾ @ 9c.; Hallett's, 8c.

Lard Oil—Prime city, present make, 47 @ 48c., in wholesale lots for a good brand, with possibly slight concessions on some.

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Manufacturers.

Harding Allen is to build a new foundry at Barre, Mass.

Smith & Conant Brothers are erecting a new plant at Pittsfield, Me.

F. H. Purington, Brunswick, Me., is preparing to make additions to his machine shop.

W. A. McDonald, of Seattle, Wash., is about to establish a box factory at New Whatcom.

The New Era Metal Company, Garwood, N. J., has commenced the erection of a new plant.

The Columbia Wagon Company, of Columbia, Pa., will commence the erection of an addition to their plant.

The steel frame of the main building at the Spreckels sugar factory at Salinas, Cal., will soon be completed.

The Preston B. Keith Shoe Company, Brockton, Mass., has decided that it will build an addition to its factory.

The Vulcan Iron Company, New Britain, Conn., desires permission to erect a new factory 40x25 feet on John street.

The Diamond Rubber Company, of Akron, Ohio, which was recently reorganized, is about to make additions to its plant.

The Thatcher Manufacturing Company has commenced work on an addition to their factory on Depot street, Pottsdam, N. Y.

The McCormick Machine Company is about to erect a $14,000 building at Madison, Wis., to be

used as a storehouse and factory. It will be two stories high and built of brick.

Chicago Bridge & Iron Company, Chicago, Ill., is to erect a one story brick shop at 10500 to 10558 Vincennes road, to cost $25,000.

The Harris Automatic Press Company, of Niles, Ohio, of which Tod Ford is president, has decided to build an addition to its plant.

The foundation has been laid for the new addition to the Fox & Mason factory, Owosso, Mich., which will be rapidly pushed to completion.

The McColl (S. C.) Manufacturing Company contemplates building an addition and adding 5,000 spindles, which would give it a total of 15,000.

The Spencer Automatic Machine Screw Company, of Windsor, Conn., recently removed its office and factory to 111 Sheldon street, Hartford, Conn.

The New Orange Machine Company, of Orange, N. J., has been incorporated by John H. Matthews, T. J. McCarthy, John F. Williams, of West Orange, N. J.

Berns & Schlee Brothers' new foundry and machine shops at Lyons, N. Y., will consist of three or four buildings. The large one will be a machine shop, and contain lathes, drills and other improved machinery.

At Quincy, Ill., the De Trays Manufacturing Company has been incorporated, with the object of manufacturing drawing instruments. Homer M. Swope, F. H. De Tray, E. B. Potter and W. F. Potter are interested.

It has been announced that Phillips & McLaren, owners of the Fisher Engine, Foundry & Machine Works, Pittsburg, Pa., which were recently destroyed by fire, will rebuild as soon as the insurance has been adjusted.

The Bellwood Manufacturing Company, Bellwood, Pa., is making extensive improvements to their works. The foundry will be increased to about twice the present size, a new cupola is being put in and other changes being made.

The Morrison Brothers, Dexter, Me., have commenced getting the interior of the White Mill into shape to start up. Men are also at work excavating for the foundation for the addition to the mill, which will be of one story and 37½x48 feet.

A charter has been granted to the Patton Wooden Manufacturing Company to manufacture spokes, handles and other products at Patton, Pa.; capital, $12,000. The directors are L. M. Patterson and G. S. Good, Lock Haven; M. B. Cowher, B. F. Wise and S. W. Worrell, Patton.

Operations have been begun on a large addition which will be built to the Kutztown Foundry & Machine Company, Kutztown, Pa., which it is hoped to complete within two months. When completed the added span will give employment to about twenty-five more men.

Articles of incorporation of the Davis Mill & Manufacturing Company, St. Joseph, Mo., have been filed. The capital stock, 2,000 shares at par value of $100 a share, is owned by Mrs. R. T. Davis, R. T. Davis, Jr., and R. M. Davis. The company will manufacture flour and cereal products.

A company has been organized with a capital of $300,000 to operate what has commonly been called the Cole Marl Beds, Coldwater, Mich., situated south of the city cemetery. It is proposed to erect the cement factory on the Stepper property and use the Stepper residence for offices.

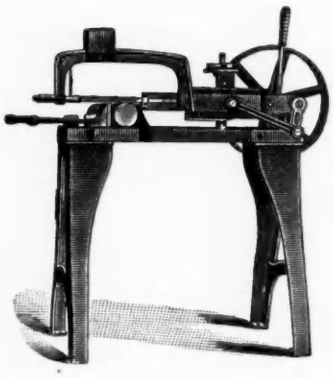
The Bemis Bag Company, Omaha, Neb., has perfected arrangements for the erection of a six-story addition in the rear of its present factory building at Eleventh and Jackson streets. The building will be 66x132 feet, with a boiler and engine house two stories high. The frame work will be of steel and the walls of brick, and

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



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Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,

For All Purposes.

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Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

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810 WALNUT STREET, PHILADELPHIA.

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HIGH GRADE
GRINDING MACHINERY.

Diamond Machine Co.,
Providence, R. I., and Chicago, Ill.

London: Chas. Churchill & Co., Ltd.
Berlin Garvin Machine Co.
Copenhagen: V. Loweners.
Paris: Fenwick Freres & Co.

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MECHANICAL DRAWING
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Specially Prepared Text Books and drawing plates free. Terms moderate. Cash or Installments. Write for free Circular T.
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ELECTRICALLY DRIVEN DRILL
PRESS

Capacity
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FRICTION
DISK
DRIVE.

Speed changed instantly from lowest to highest.

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STANDARD MEASURING MACHINES

12 to 48 in. capacity.

Including Microscope and Graduated Bar for insuring absolute standard uniformity. The new Decimal Gauge.

CYLINDRICAL AND CALIPER GAUGES,

Straight and Taper Solid Hand Reamers, Chucking and Shell Reamers, Arbors and Steel Mandrels, Locomotive Taper and Taper Pin Reamers, Combination Lathe Chucks, Milling Cutters. *Ask for the Machinists' Catalogue.*

THE PRATT & WHITNEY COMPANY,
HARTFORD, CONN., U. S. A.

NEW YORK, 123 Liberty Street. BOSTON, 144 Pearl Street. CHICAGO, 42 South Clinton Street. LONDON, ENG., Buck & Hickman, 2:0 Whitechapel Road. PARIS, FRANCE, Fenwick Freres & Co., 21 Rue Martel.

ENGINE and SPEED LATHES

IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U. S. A.
Agents: SELIG, SONNENTHAL & Co., London, Eng.; JOHN TRAGARDH & Co., Göteborg, Sweden; F. SONNENTHAL, JR., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

An Elementary and Complete Course in Mechanical Drawing.

By JOHN S. REID, Sibley College. Cornell University.
8vo. Cloth. Illustrated. $2.00.
JOHN WILEY & SONS, 53 East 10th Street, - New York City.

GENUINE LIGHTNING SCREW PLATES,

Taps, Dies, Reamers, Green River Screw Plates, Bolt Cutters, Drilling Machines, Etc.

Send for Catalogue.

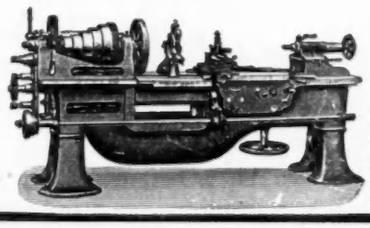
WILEY & RUSSELL MFG. CO.
GREENFIELD, MASS., U. S. A.

Agts. in London, SELIG, SONNENTHAL & Co., 85 Queen Victoria St.

PUTNAM MACHINE CO.,

The Oldest and Most Extensive Builders of Lathes in America.

LATHES, PLANERS, DRILLING MACHINERY, MILLING MACHINES, SLOTTERS, SHAPERS, GAP ENGINE LATHES.



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Jenkins Standard '96 Packing

weighs 33-1/3 per cent. less, does not **Rot, Burn** or **Blow Out,** and will last longer than other joint packings; therefore the cheapest and best for all purposes.

Good buyers compare weights.
Genuine stamped like cut.

JENKINS BROS., New York, Boston, Philadelphia, Chicago.

BRADLEY HAMMERS

Have never been equaled for quantity and quality of output, simplicity, durability and freedom from repairs.

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Foreign Agents:
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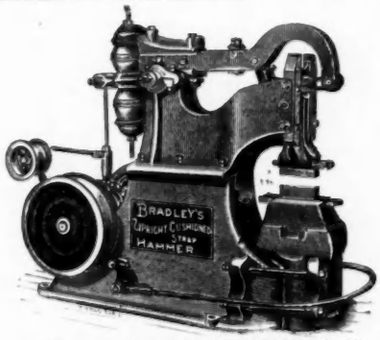
Schuchardt & Schutte, Berlin, Vienna, Brussels.
Fenwick Freres & Co., Paris.



THE BRADLEY CO., SYRACUSE, N. Y.

when completed will be supplied with modern mill machinery. The motive power of the new plant will be electricity.

The War Eagle Mining Company, of Rossland, B. C., recently placed an order with the James Cooper Manufacturing Company, Limited, of Montreal, for the largest individual air compressor ever built in the Dominion of Canada. When in operation this machine will have a capacity of fifty drills, and will be the pioneer of its class in Canada, being driven by electric motor. Some idea of the size of the machine can be gathered from the size of the fly wheel, which is 22 feet in diameter, and will weigh in the vicinity of 25 tons.

Work has commenced on the 40x60 brick boiler house for the Brenham Compress, Oil & Manufacturing Company, Houston, Tex. It is to be built for the purpose of combining their battery of five boilers used to run the electric light and ice plant, and the building will be between the electric light plant and the ice factory, filling in almost the entire space between these buildings.

The Diamond Match Company announces that the machine shop of the company, now located at New Haven, Conn., will be removed and added to the machine shop at Barberton, Ohio. This will necessitate the erection of a new building two stories high, 200x50 feet, and the employment of 100 more skilled hands.

Notwithstanding the fact that the Bethlehem Iron Company, South Bethlehem, Pa., have on their books large orders for finished guns of various calibers up to 12 inches, gun carriages and forgings for guns which are to be completed at the various Government yards, the number of orders which they are taking for merchant work, such as shafting of various descriptions, both solid and hollow, and of plain steel as well as nickel steel, are increasing daily. Recently they were asked to quote a price on shafting for a Japanese torpedo boat which is being built in Japan. For this order they were asked to compete with such concerns as Vicker's Sons & Co., England; Krupp, of Germany, and Schneider & Co., of France.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the Challenge Machine Company, Philadelphia, 1898 catalog of grinding and polishing machinery, including cutter and reamer grinders, bench grinders, twist drill grinders, etc. The catalog is standard size, 3½x6 inches.

We have received from the Chandler & Taylor Company, Indianapolis, Ind., catalog of automatic cut-off steam engines. The various parts of these engines are described in detail, together with illustrations of the engines. The catalog is standard size, 6x9 inches.

We have received from Jenkins & Lingle, Bellefonte, Pa., catalog of power hammers and shears. The catalog also describes Chase's vise stand, by means of which machinists, gasfitters, etc., can set up a vise in a short space of time. The catalog is 5½x7¼ inches.

We have received from the Norton Emery Wheel Company catalog of the Walker universal tool and cutter grinder. The catalog contains some very useful tables, such as emery wheel speeds and decimal equivalents. The catalog is standard size, 6x9 inches.

The Bignall & Keeler Manufacturing Company, Edwardsville, Ill., has sent us catalog No. 14 of pipe threading and cutting machines, wrenches, pliers, etc. The catalog contains, in addition to descriptive matter relating to the various devices, some useful tables, etc. It is 4½x6½ and will be sent to any interested upon application.

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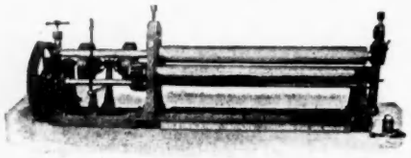
LONDON, H. Munzing. BRUSSELS, A. Hennuy. LUCERNE, Franz L. Meyer. CHRISTIANIA, C. S. Christensen. PARIS, L. Masson & Co. VIENNA, White, Child & Boney. BREMEN, August Eggers.

For Advertisement of
TIGHT JOINT CO., New York.
See Issue April 7, 1898.



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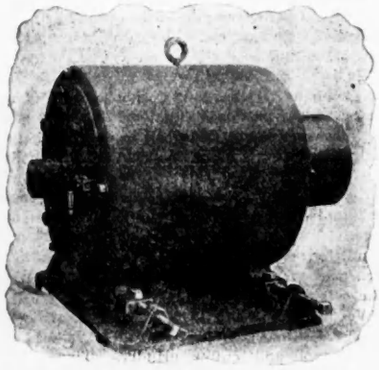

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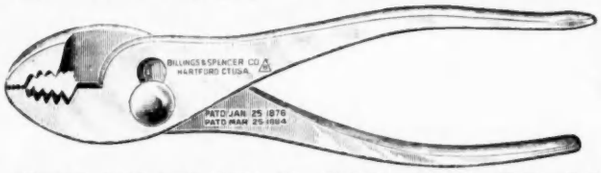

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AGENTS: U. Baird Machinery Co., 125 Water Street, Pittsburg, Pa.
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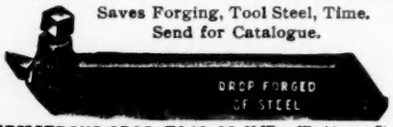

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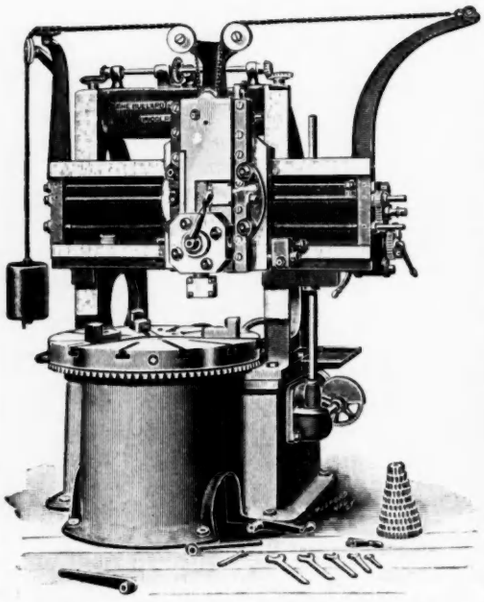

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